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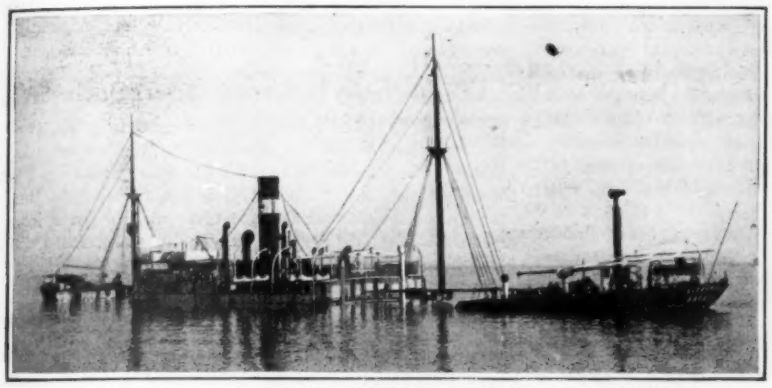


The German steamer "Liebenfels" sunk in Charleston harbor

Seven feet of water over the deck of the ship at high tide

The Cunning Displayed in the Sinking of the German Steamer "Liebenfels"

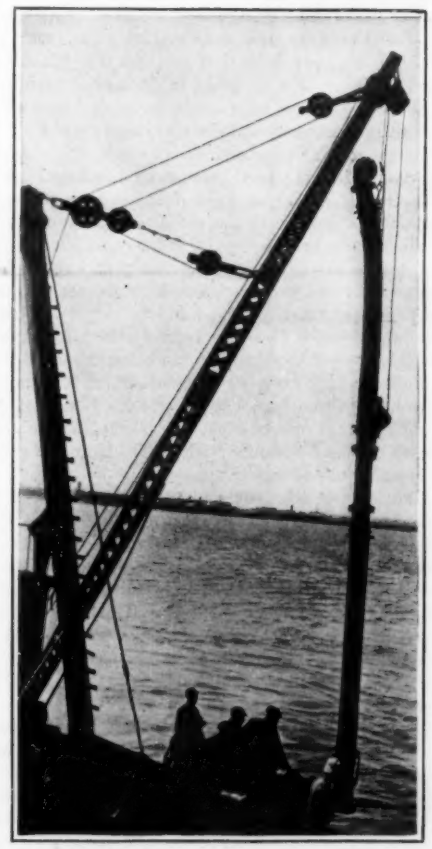
GERMANY may well claim to be a master in the art of destruction, not only of the coarse and brutal variety, but also in the finer and more subtle technique of the finished crook. How well schooled are her people in these arts is exemplified by the sinking of the steamer "Liebenfels" in the harbor of Charleston, S. C. on February 2d. Never was a ship more cleverly sunk. It was anchored off the channel leading to the Navy Yard. Evidently word of a coming break in diplomatic relations between our country and Germany had reached the captain of the vessel some time in advance. The work that was done on the "Liebenfels" to insure its foundering was most thorough and must have consumed considerable time.

On the morning of the second of February, the ship was seen to be in a sinking condition and two tugs put off to its assistance. They found three men on board, the first officer, the chief engineer and a colored man. They admitted that the vessel was in trouble, but refused any assistance as long as the captain was not there.

It was observed that a dead light under the counter on the starboard side was open, but although attention was called to this no effort was made to close it. The covers of all hatches, except one, were displaced. During the forty-five minutes that the tugs stood by, the water rose three inches in the vessel. Slowly the ship went down and sank in water thirty-two feet deep at low tide.

It was apparent that the sinking was intentional and designed to block the channel to the Navy Yard. Evidently the time of the sinking had not been carefully calculated, for by the time the vessel went down the tide had swung it about so that it did not lie directly across the channel, but blocked it only partially.

To Major G. A. Youngberg of the Corps of Engineers, stationed at Charleston, fell the duty of removing the obstruction. He immediately used all the forces at his disposal. There were Navy divers in port who were called upon to investigate the wreck. As it was realized that the sinking was done deliberately, a careful study was made of the situation in order to discover what possible means of sinking the vessel could have been employed. It was determined that twenty-eight different things might be done which would admit water into the vessel in such a way as to escape the observation of any but a very careful diver. When the diver entered the hold and examined the wreck he discovered that the crew had used twenty-seven of the twenty-eight possible schemes. We are not permitted to enumerate them all, but as an illustration of the cleverness of the Germans we may call attention to some of the means they employed:



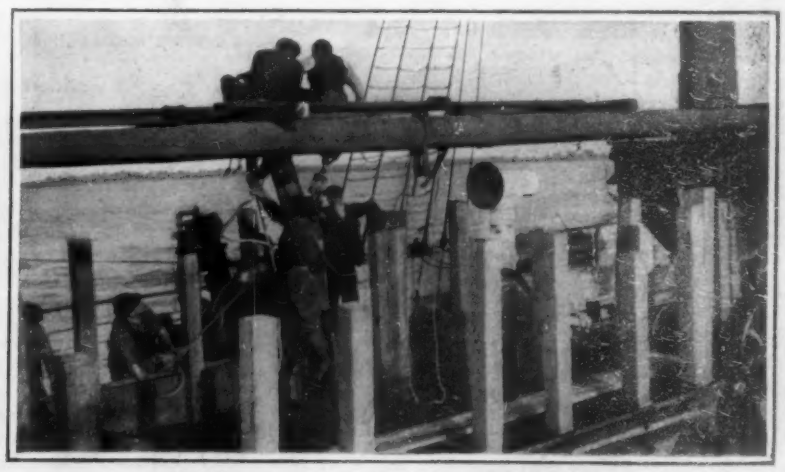
Suction pipe for a salvage pump being lowered into the hold of the wreck

A modern ship is equipped with a double bottom in which space fresh water for the boilers is commonly kept, as well as salt water to ballast the ship when she carries no cargo. There is a piping system leading from the double bottom to the boilers, and pumps to force the water to them. There is also means of introducing water into the double bottom from the sea so that in case of emergency, salt water might be used in the boilers. In addition to this, there is a system of piping running to the condensers and also to various parts of the ship to supply salt water. This has direct connection with the sea through a main sea valve and in addition to the system to the main condensers, there is a system connecting with the auxiliary condenser. The divers found that the valves in these systems of piping had been tampered with in such a way as largely to escape observation. For instance, the valve would look complete and in perfect condition, but when the valve cover was lifted it would be found that the valve disk had been removed and then the cover replaced to conceal the mischief. Thus the entire piping system of the vessel was open to the sea.

The manholes that open into the double bottom of the vessel were not directly opened, but had been slacked off slightly so that there would be a considerable leakage through them. To all appearances they were closed and certainly a diver working under conditions of semi-darkness would be led to believe that they had not been tampered with. But upon investigation it was found that many of these manholes had been dropped half an inch or so, so as to permit the water

(Concluded on page 379)

One of the powerful salvage pumps discharging 750 tons of water per minute



Building a cofferdam around one of the hatches

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The President's War Message

OCCASIONALLY in the great crises of human history it has happened that the whole world, of whatever race, creed or tongue, by common consent, has given ear to the voice of one man. Conspicuous among such occasions will ever be reckoned the joint session of the two branches of Congress, which gathered on the night of April 2d to learn from the lips of the President of the United States why it was that the great republic, of which he is the executive head, was compelled to declare that a state of war existed between itself and the greatest military autocracy of all time.

His audience on that fateful night was greater than the few hundreds which sat within reach of his voice, greater even than that contained within the bounds of these United States, and extended, in truth to the uttermost ends of the earth. Never, surely, was a public utterance awaited with greater anxiety than this noble and inspiring address, calling upon the country to wage war in defense of those great principles which are the foundation of all true democracy.

Acting as the drop of liquid with which the chemist clarifies a cloudy mixture in his test tube, the words of the President have served to remove the last doubt as to the practical unanimity of the people of this great republic on the question of the true meaning of the present world war. The American people believes with its President that the conflict, in the last analysis, is a struggle between autocracy and democracy, between the right of a privileged few to rule the peoples of the world for their own private ends and the right of every nation, big or little, to govern in the interests of its collective citizenry.

Particularly acceptable to the American people is that portion of the President's address in which he makes it clear that we enter the war, not as a struggle against the German people, but against that military clique which has led them, deluded and unsuspecting, into a war of aggression and attempted world conquest. The citizens of America have no quarrel with the citizens of Germany, rather they have for them and for their notable industrial and social achievements, the profoundest admiration.

In keeping with the past traditions of the country and unquestionably reflecting the spirit of the people, was the President's avowal that the country would enter this conflict with its whole heart and that it would wage war in complete coöperation with the Allied powers. The great principle of alliance having been thus clearly stated, the details of the method of coöperation can safely be left to the naval, military and financial advisers of the President.

The Removal of Major-General Wood

WHEN the record of the present momentous times in America comes to be written, the historian will allot no little space to the rise and growth of the great citizens' military preparedness movement. So far as we know it is unique. Nothing of the kind, and certainly nothing of equal extent, has been known in this or any other country.

The preparedness movement was based upon the conviction that, in view of our lack of Naval and Military defenses, the great war in Europe held a very special and sinister significance for this country. The people of America by a concerted and non-political movement have engaged voluntarily in Military service in various parts of the country and have secured appropriations for Naval and Military defense, greater as far as public records show, than have ever been granted in this or any other country in peace times for a like purpose. The movement culminated in a demand which was so widespread that the President did not hesitate to include a recommendation for universal service in his recent momentous address before Congress.

Now, if there is one man more than any other who stands in the eyes of the American public as the symbol of this preparedness movement, it is Major-General Leonard Wood. One of the most popular and trusted of our great military men since the days of Ulysses S. Grant, to his initiative was due that great educative movement known as the Plattsburg Camp. It was he above all others who drew the attention of the American public, as far as he could do so consistently with Army regulations, to the alarming state of unpreparedness of this country, particularly as regards its shortage of military equipment; and it is to him that the great national movements for defense, such as the National Security League, the American Legion and others were indebted for the facts upon which their compelling arguments were based.

Because of his great administrative ability and his virile patriotism the American people felt that it was very opportune that General Wood should, in these perilous times, be holding the position of Commander of the department of the East, the most important assignment of its kind in the War Department. Hence, it was with profound amazement and regret, and with very grave misgivings, that the country recently learned that General Wood was to be transferred from the Department of the East to a comparatively insignificant command, practically without troops, to be known as the Southeastern Department, which has been created by splitting up the original Department of the East into three separate commands.

When the seriousness of this plan is fully understood, it is hoped that the President will interpose his good offices to put a stop to the completion of the proposed order for dividing the Department, the need for which has never been explained and which seems to bring about a condition which will actually weaken, rather than strengthen, the military efficiency of the present Department of the East.

Should the proposed plan of dividing the East into three Departments and the placing of General Wood in a minor position be carried out, the War Department will be subjected to the severest criticism, and the suggestion is likely to arise that General Wood has been demoted because of his activities in the way of preparedness. Before the new plan could be carried into effect the war will be upon us, and the carrying forward of any such change as that proposed would cause in the minds of the public the greatest amount of misapprehension and misgiving. It would mean delay and an unavoidable amount of confusion and readjustment at the very hour when time is the very first consideration. The President alone can forbid an eleventh-hour change which is fraught with the greatest danger to successful prosecution of the preparation program.

The plan proposed does not appeal to the business and professional men of the country and others charged with large affairs. There is a well-known saying that it is a poor plan to change horses while crossing a stream and we might add that it is an especially poor plan to change from a horse who is familiar with all fords and currents at the crossing to one new to the stream.

In addition, no business man would attempt to reorganize his various departments in the midst of a business crisis; nor even in ordinary times would he attempt a great reorganization in one step. He would endeavor to make the reorganization progressive, leaving his general manager in supreme control until the subordinate departments were running smoothly. To attempt to do otherwise would mean a practical cessation of all business, and it is this which threatens the Eastern Department today.

Now, even if this plan be followed, there should remain one supreme commander at the Eastern Coast, to whom all matters of larger military importance should be submitted. This would be to act with good common sense and in accordance with accepted business principles. Obviously, if this subdivsion of General Wood's Department is made, he should be placed in supreme command. To remove him at this hour of crisis is to disturb the country at the very time when everything should be done to strengthen the confidence of the American people and of our Allies in the impartiality and wisdom of the responsible authorities.

A Great Work Well Done

AS a relief from the nightmare of the great war, it is with pleasure that we record the completion of one more of those great engineering works of peace which are among the glories of the age in which we live. We refer to the placing in service of that fine structure across the East River known as Hell Gate Bridge, which serves to give continuous rail connection between the New England States and the great railway systems lying to the south and west of this city.

From a technical standpoint, this work is notable both for its over-all length of about three miles and for the fact that it includes the greatest railway arch ever erected. The structure which serves to span the main channel of the East River has a clear width between abutments of 1,000 feet and the topmost point of it rises to a height of 305 feet above the East River.

The roadbed contains four tracks and the arch is calculated to carry a load of four of the heaviest freight trains covering the span from end to end. Naturally an arch of this length and carrying capacity is unusually heavy and contains members of exceptional size. The weight of the span per lineal foot is 26 tons and the main compression members of the arch, which are of square section, measure 5 feet in width and about 10 feet in depth at the abutments.

Our notice of the opening of this structure would not be complete without making mention of Gustav Lindenthal, the designer, whose work as a bridge engineer has contributed so largely to the prestige which the American bridge builder holds throughout the world. It was Mr. Lindenthal who formulated the first practical plans for a great suspension bridge across the North River—a project which, in view of the phenomenal growth of the traffic, railroad and vehicular, between Manhattan and New Jersey may yet become an accomplished fact, in spite of the present talk of constructing a tunnel to perform the office for which the bridge was originally proposed.

An Opportunity for German-American Clubs

DURING the past two and one-half years, the position of the native-born German or the German-American with strong affiliations with the Fatherland has been a trying one. Owing to the machinations, plots and lawlessness shown by spies, certain German officials and over-zealous partisans, acts have been committed against the sovereignty of our nation and its peace and welfare which have been, in many cases, criminal in character, and which in any other country than this would have aroused the most serious outbursts of indignation. Because of such acts, many of the better class of Germans and German-Americans have been unjustly, and often irrelevantly, reproached with lack of loyalty—a result which, under the circumstances was inevitable.

The time has now arrived, however, when this very class of our citizens has been brought to the point of deciding whether to retain their allegiance to their former home or to come out openly and candidly in support of the country of their adoption. The imputation of disloyalty may still be an unjust one; but it can no longer be regarded as irrelevant. There is no half-way position, now that our country is at war. In the past, the German residents of the United States have proved to be, in the main, a staunch and splendid body of citizens; and, up to the time of the war they held the respect of the better part of the community. An immense number of these German subjects has recently taken out papers of citizenship. Many have doubtless done so from motives of conviction; many have taken the oath to safeguard themselves from being placed in detention camps.

For those who have a genuine love for the flag of our country, however, a mere attitude of passivity will not suffice, nor will merely the wearing of a little flag in the buttonhole. The German-Americans residing here have in the past missed a great opportunity to bring to the German Imperial Government a realization of the extraordinary indignation which is being aroused in this country by the outrages against humanity committed by the German arms, and it appears that the Imperial Government has not been well informed in regard to the trend of thought in the United States. Had the Germans themselves, and the German-Americans, carried forward a program of enlightenment in Germany, they might have done much to stay the hand of that country during the past two and one-half years.

Although this period has now passed, there is still a great work which might be accomplished by the Germans individually and collectively, and above all, by the great and powerful German Clubs and Associations throughout the land.

It is in their power to show, if they wish, their loyalty and devotion to the country of their adoption by using all their efforts to put a stop to the machinations, plots and unlawful acts of certain of their countrymen, about which they are in a better position to be informed than anyone else. If these clubs are really patriotic, they can put a stop to the conspiracies of certain unscrupulous individuals, who live in our midst, not as peaceful citizens, but as malignant enemies. By such disclosure the German-American Clubs can render a real service to the citizens of this country, both German and American. The committing of outrages would provoke serious internal conditions, from which, in the end, the Germans themselves would be the chief sufferers. If there is no higher motive in such a policy than that of self interest, it would seem that this alone should cause some very active measures to be taken by these clubs and societies.

Certain members of the older clubs have resigned because of their unwillingness to serve two masters. Men of this stamp could do a great service within the clubs themselves, by so-shaping the policy of the organizations that they will be a distinct asset to the commonwealth

Astronomy

Photographing Stars in Daylight.—In a recent paper read before the Royal Astronomical Society, Dr. Lindemann stated that, using filters to cut off the rays of short wave-lengths, he had been able to photograph stars down to the third magnitude with a 6-inch equatorial at midday. He has photographed stars within 20 degrees of the sun.

Sir William Herschel's Double Star Measures.—In a recent number of the Monthly Notices Mr. W. S. Franks calls attention to some remarkable systematic errors in Sir W. Herschel's measurements of double stars. A comparison of his measurements with those of later observers shows that for fairly wide doubles (16 seconds and upwards) Herschel's values require a plus correction of 5 to 8½ per cent. This is a matter of some importance, since Herschel's measures of wide doubles are sometimes quoted in conjunction with modern ones, with an interval of a century or so, and the difference is attributed to proper motion.

Solar-Constant Studies in South America.—The Smithsonian Institution has recently made an allotment from the Hodgkins Fund to the Smithsonian Astrophysical Observatory for the purpose of duplicating the solar-constant work of Mount Wilson "at the most favorable station on the earth." An expedition is accordingly being prepared to go to South America next summer. It is intended to continue solar-constant determinations by the spectro-bolometric method on every favorable day for several years at both Mount Wilson and the South American station, with a view to determining the dependence of the earth's climatic conditions on the variations in solar radiation.

Needs of Astronomical Research.—The Committee of One Hundred on Scientific Research of the American Association for the Advancement of Science has received from its subcommittee on astronomy a list of objects to which research funds might be advantageously applied in that science. Noteworthy suggestions include "re-establishing the friendly international relations of astronomers of three years ago" by assisting international undertakings; furnishing assistants to astronomers, to relieve them of laborious routine observations and computations; increasing astronomical work south of the equator; and establishing bureaus to undertake, at the request of astronomers, such work as the computation of orbits, measuring photographs, determining radial velocities from spectra, etc.

Apparatus for Photographing Meteors.—The meteor committee of the American Astronomical Society has secured a design for apparatus suitable for making photographic observations of meteors. The sky is to be photographed on a highly sensitive film, renewed each minute, using a sort of enlarged and simplified motion picture camera. The committee has undertaken to have such cameras constructed for astronomers who are willing to make the observations, which will include: (1) Angular position and direction of trail from stellar images; (2) parallax and distance, from difference in angular position in images taken, say, five miles apart; (3) velocity, from duration and parallax (the beam to be interrupted five times a second by a sector shutter just behind the lens); (4) time of appearance, obtained by photographing a clock-face in the corner of each picture.

Civil Twilight.—Recent publications by Prof. H. H. Kimball bring to our notice the useful conception of "civil twilight." This may be roughly defined as the period after the setting or before the rising of the sun during which there is enough daylight for working out of doors or for reading ordinary print indoors. It ends in the evening and begins in the morning when the sun is about six degrees below the horizon, corresponding to the moment when first-magnitude stars are just visible. In the evening and in clear weather it ends with the disappearance of the ordinary "purple light" of the western sky, and in the morning it begins when the "purple light" appears in the eastern sky. Civil twilight is distinguished from astronomical twilight; *i. e.*, the interval between sunrise or sunset and complete darknes, limited by a solar depression of about eighteen degrees. Here are some notable facts about civil twilight: The conception appears to have been introduced into science by J. H. Lambert about the middle of the eighteenth century, and the terms "bürgerliche Dämmerung" and "crépuscule civil," equivalent to "civil twilight," have been current in German and French literature, respectively, for much more than a century. Yet both the name and the idea seem to be unknown to scientific writers of English speech. Nothing is said about civil twilight in our books on astronomy or our encyclopædias. This is the more strange because the twilight period during which there is light enough for ordinary daytime occupations is, from a practical point of view, far more important than the rest of the "astronomical" twilight. Prof. Kimball has published tables for the duration of civil twilight in different latitudes and months, which will doubtless be widely used in courts of law as well as by the illuminating industries.

Science

Measuring the Surface Area of the Human Body by photography has recently engaged the attention of Dr. F. G. Benedict. His method was developed primarily for the purpose of securing measurements of a subject who had undergone a long fast, in connection with nutrition experiments. Certain definite poses are used (particularly a side view with arm extended), and comparisons between the photographed areas and the body-surface as computed from the Du Bois linear formula show a remarkable constant relation.

Delicate Measurements of Plant Growth.—Dr. D. T. MacDougal has designed a new "auxograph" for registering changes in the volume of growing organs of plants. This consists essentially of a delicately balanced compound lever, carrying a tracing-pen on one free end and having an arrangement by which the movement to be measured may be applied at various intervals on the other free arm. The record is traced on ruled paper, wound around a clock-driven cylinder. With this instrument it is possible to register changes in size as small as 0.0004 inch.

Research at Cambridge University.—One result of the war is that Cambridge University, in England, has established two new research degrees; viz., Master of Letters and Master of Science. The purpose of these is to encourage students to remain in residence for one or two years after they have completed their work of the Tripos (the honor examinations) and engage in research under suitable direction. Although chiefly intended for Cambridge graduates, the new degrees are open to properly accredited graduates of other universities. Another innovation at Cambridge is the establishment of an Institute of Agricultural Mechanism, to be devoted to the investigation of problems relating to farm machinery.

Vertical Earth Currents.—Drs. W. F. G. Swann and S. J. Mauchly have been making some laboratory investigations at Washington with a view to installing apparatus for the automatic registration of earth currents. In this connection they have sought the origin of vertical earth currents, described by many observers as having densities of an order of magnitude much larger than the vertical atmospheric-electric current density. Their experiments show that these currents can largely be attributed as regards both their nature and their magnitude, to spurious effects introduced by the apparatus through differential effects of such agencies as temperature or hydrostatic pressure, for example, at the electrodes.

Oxygen Requirements of Roots.—Messrs. B. E. Livingston and E. E. Free have reported a number of observations indicating that the aeration of the soil is a much more important factor in plant ecology than has hitherto been suspected. They have found, for example, that heliotrope and *Coleus* require the maintenance of a certain oxygen-content in the air of the soil about their roots in order to thrive. The roots of oleander, on the other hand, appear to require much less oxygen than the plants above named, and the injury produced by entire deprivation of oxygen is much less quickly developed. The roots of swamp willow appear to be unaffected by a lack of oxygen; they grew normally for periods as long as ten weeks with no oxygen in the soil.

The Most Fragrant Wild Flower.—Readers of the *American Botanist* have been trying to decide which is the most fragrant American wild flower, and their opinions on the subject exhibit remarkable diversity. In New England the majority give first choice to the pink azalea, with the white water lily second. There are many votes for the trailing arbutus, but, as the editor suggests, its fragrance is doubtless overestimated, owing to the fact that it is the earliest fragrant wild flower of spring. Other candidates for first place are the partridge berry, the common locust, horned bladderwort (of which John Burroughs says: "In a warm moist atmosphere the odor is almost too strong"), yellow jessamine, spotted wintergreen, and some of the magnolias. The same journal is collecting opinions as to which wild flower is the most beautiful.

The Cinchona Botanical Station.—It is announced in *Science* that the botanical station at Cinchona, in the Blue Mountains of Jamaica, formerly leased for ten years by the New York Botanical Garden, has been taken over by the Smithsonian Institution on behalf of fourteen American botanists and institutions. It is hoped to make of this establishment a counterpart, in the American tropics, of the well-known Buitenzorg Garden of Java. The station comprises a furnished residence, three laboratory buildings, two glass propagating houses, and a garden of ten acres. Moreover, occupants will have the privilege of studying and collecting over the many thousand acres of the Cinchona reservation and on certain neighboring estates, besides having opportunities for study at Hope Garden, Kingston, with its library, herbarium and rich collection of growing plants, and Castleton Garden, which has a fine collection of cycads, palms, *Ficus*, etc.

Aeronautical

Aerial Means of Propaganda have evidently been adopted by the Germans, according to a recent report of the finding of a small German balloon to which were attached fifty newspapers printed in the French language, which fell on the trees near the Petit Palais in the Champs Elysées, Paris, on the evening of February 7th. The balloon was handed over to the military authorities, so that this particular propaganda effort fell on deaf ears.

Unusual Method of Lateral Balance.—In the Spanish "Delta" type biplane, a rather unusual device is employed for maintaining lateral stability. Mounted on the top plane, right above the forward cockpit, are two stout braces, each of which holds a simple form of rudder. It is by the manipulation of these additional rudders that the pilot restores lateral stability, and it would be interesting to know just how successful the device has proved in practice. At any rate, there does not seem to be any advantage gained over the usual warping wing or aileron methods.

The Unwieldy Zeppelin.—A Swiss despatch states that according to information from Berlin, consternation has been caused in German Parliamentary circles by the news that the aerial experts of the General Staff have advised the Minister of War not to construct more Zeppelin airships for the army. At the same time it has become known that the naval advisers also urge that Zeppelins should be used only for scouting, and only secondarily, if at all, for attacks on enemy countries or enemy fleets. Both groups of experts based their recommendations on the argument that practical experience has revealed great defects in the Zeppelin, which is condemned as being "too unwieldy, too susceptible to weather, and altogether too vulnerable," according to *Aeronautics*. The British look upon this information emanating from Swiss circles as a *ruse de guerre*, intended to throw the defending forces in England off their guard, which would give the Zeppelins a better opportunity of scoring successes in future aerial raids on English territory.

A Monoplane with a Steam Rotary Motor.—John Wilson of Hutchinson, Kans., is reported to have finished a steam-driven monoplane. The machine is claimed to be the only steam rotary motored monoplane in the United States. The designer has studied this type of engine for more than ten years. He built nine other engines before this his tenth one satisfied him. The machine was set up in a local factory. He has the machine almost ready for exhibition at the Kansas State Fair, and after the fair, during which time he will test it, he expects to be able to pilot the machine on its first flight. The machine, continues *Aviation*, is 25 feet long, with a stream-line body, tapering from 3 feet in diameter at the front, to a point. It is made of well-seasoned spruce, guyed with stout steel guying wire, and the body covered with sheet aluminum. The body has a hood of heavy hammered copper. The planes are 35 feet wide, and have a wing surface of 240 square feet. The machine weighs 850 pounds and has a lifting capacity of 1,200 pounds at 30 miles per hour. The weight includes machine, motor, passengers, and fuel, and it is claimed for the monoplane that it can make 90 miles an hour. A steering mechanism, having a three-in-one movement, is a part of the equipment, and the tail planes, rudder and elevator are of the inverse curve type. The wheels are stream-like, made of solid metal, and fitted with pneumatic tires. The engine, which with its generator weighs but 300 pounds, was designed by John Wilson.

Breaking in Army Recruits.—There has been much activity at the Hempstead Plains, or Mineola, aviation field during the last few days, and preparations have been progressing rapidly to break in twenty-seven young aviators who have enlisted in the United States Aviation Corps, according to the *Aerial Age Weekly*. Their instruction has begun and will be continued every day until they thoroughly understand it. Almost any day now fifty machines are expected at the camp, and this number will be increased until there are seventy-five aeroplanes of various types on the field. Special quarters have been built for the men so that they may be comfortable. Among the equipment on the field will be six pursuit planes, two triplanes, two biplanes and two monoplanes. The machines are also to be equipped with stabilizers and contain a small gun, which can be operated by the pilot. A feature of the new machines received is the unobstructed view which the pilot will have. The new machines that have arrived are equipped with cameras, which are operated with a trigger and can be used for photographing the country over which the aviator is passing. Captain Kilner, who is in charge of the field, plans to have the men instructed according to the French method. This is by having them fly in one direction and behind each other for one day, then to follow the same process in the opposite direction the following day. As soon as the weather permits the million and a half candle-power searchlight will be used and night flying tried. The men are very enthusiastic over their work and are getting into the groove with remarkable quickness.

The puffballs. Young specimen at the left is in the proper stage for eating

Common Edible Mushrooms

A Few Unmistakable Varieties That are Fit for the Table

By Albert A. Hansen

Photographs by L. O. Overholts

Shaggy-mane ink-cap. A variety growing freely in lawns

WHILE in Europe the people at large have always studied mushrooms as we are inclined to study flowers, public interest here in these strange members of the vegetable kingdom has but just begun to waken. Perhaps this is to be attributed to the proverbial economy of the European people, who are ever ready to adopt any aid in reducing the cost of food, and to the fact that the increasing economic pressure in this country has until now never been sufficient to impress upon us the need for taking every advantage in the struggle for daily bread.

But even though most of us are now really interested in the mushrooms as a source of food, the prevailing ignorance regarding them is appalling. This may be traced to the fact that mushrooms vary in kind by the hundred, there being over a thousand species in the United States. But the same may be said of flowers; and yet the commonest of our flowers are fairly well known by a great many people. Why should not the commonest of the mushrooms be equally as well known?

The greatest drawback to the study of mushrooms as a source of food is the fact that some are known to be dangerously poisonous. And the unfortunate feature is the fact that no rule can be given by which the poisonous species may be differentiated from the edible forms. The silver-spoon test, pink gills, death cup, manner of peeling; all these fallacious tests are but evidence of the credulity of the American people in believing stories entirely unsupported by scientific observations. There is but one rule to follow when gathering mushrooms with the intent of using them for food—collect only those with which you are intimately familiar beyond a particle of doubt. Unknown or unfamiliar forms should never be eaten until accurate knowledge is obtained that they are definitely non-poisonous.

There are a few edible kinds, however, which are of common occurrence and are so characteristic in appearance that identification is simple and positive. It is my purpose to describe these forms, the scope of the article purposely including only those of such easily recognizable characters that there will be little danger of confounding them with the poisonous varieties.

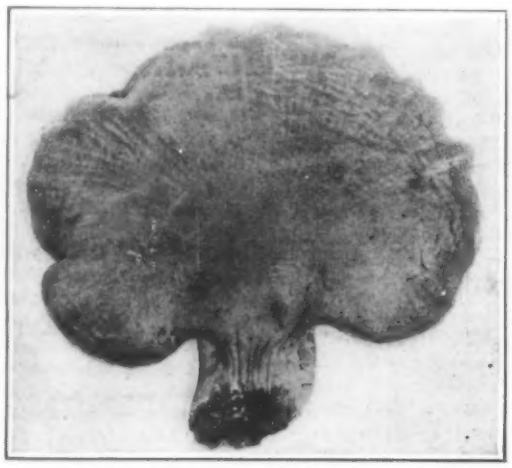
Possibly the most characteristic group of edible mushrooms is the morel. A close study of the accompanying illustration will at once acquaint the reader with the character of this group. There are no other mushrooms which closely resemble the morels, so there is little danger of going astray. There are many species, but to the casual observer they all look alike; the characteristics separating the various members present a problem for the expert rather than for the beginner.

On account of the deeply pitted heads, they are frequently known as the sponge mushrooms. The heads are usually brownish, while the stem is white, strong and hollow. The morels are vernal forms, frequently appearing in large quantities during a rainy spring, inhabiting stream banks, woods and orchards. As a rule, they are seldom found growing over four inches tall. The sponge mushrooms are inclined to be tough in texture, hence they should be cooked slowly and long. A panful of morels, cooked for an hour with plenty of butter, salt and pepper and a small amount of lemon juice is a gastronomic treat worthy of the Cæsars. A little beef gravy added from time to time during cooking will add zest to the flavor.

Another extremely characteristic group, all members of which are edible, is the coral mushroom. They grow in almost all localities, preferring damp shady woods from early June to November. Their common name refers to their close resemblance to clusters of coral, a character which renders them easily recognizable. Some of the coral mushrooms are extremely tender and when properly cooked yield a dish fit for a king. Coral mushrooms are practically all white or brownish in color.

Among the most common and most readily recognizable members of our edible mushroom flora are the puffballs. Strangely enough mushroom lovers have been slow to recognize them as edible forms. In order to be certain that puffballs are being dealt with and not the juvenile stage of poisonous plants, the specimen should be first cut. If the entire interior is white and of a uniform structure, somewhat resembling cream cheese in appearance, there is no danger of confusing with poisonous mushrooms. Occasionally the interior may be discolored by the production of spores; such forms are too mature and hence unpalatable. After peeling and slicing the puffballs may be prepared by any of the recognized culinary methods. They are particularly to be relished when served with steaks.

Possibly the most delicious of all mushrooms, whether wild or cultivated, is the oyster mushroom. It grows profusely upon decaying logs; the discovery of such a colony has brought joy to the heart of many a woodsman and pleasant gratification to the appetite. The fruiting bodies are large and of an immaculate white appearance. Insects seem to be especially fond of the oyster mushroom, sometimes spoiling them as food for man. This is one of our most abundant and readily recognizable forms, and especially to be commended to the beginner, since there is no poisonous plant which it resembles sufficiently to cause confusion. The writer has known of a single fallen tree producing a crop of oyster mushrooms sufficient to supply all the mushroom needs of a party of eight for a period of two weeks. The supply seemed constantly to be renewed in a most accommodating manner. The secret of obtaining the finest flavor lies in proper preparation. If the supply is sufficient to permit a choice, the youngest brackets should be selected and should be slowly cooked for from twenty to thirty minutes. Also, fried in a bread-crumb batter in a similar manner to oysters, they are delicious. This mushroom seems to have no preference as to the kind of wood it grows upon, all that seems necessary is a decayed log in the proper environment. The oyster mushroom should offer possibilities as a cultivated form, provided a sufficient number of decayed logs are available, since the inoculation of the log by means of spores should not be a difficult matter. Wild animals are fond of this plant.

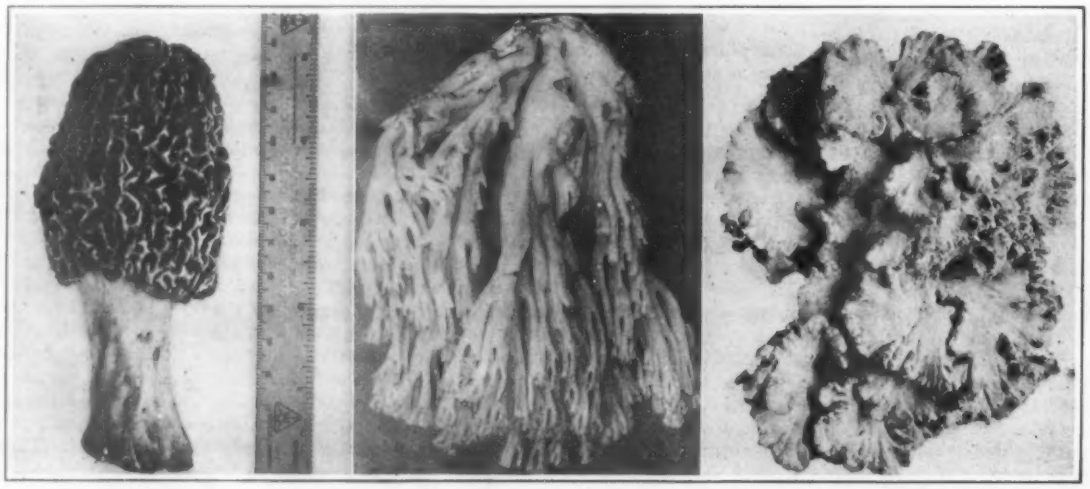


Beefsteak fungus. Showing the fleshy under surface

Oyster mushroom. Showing the under surface with the characteristic gills

One of the most massive of all our mushrooms is the sulfur mushroom, so named because of the sulfur-like color and odor, though streaks of red or white are not infrequent. It grows in generous masses upon living trees or sometimes upon stumps. The writer has seen enough of this fungus to fill a bushel basket growing in a single mass. Occasionally a lemon-colored milk is present and flows when pieces of the mushroom are broken off. In spite of its unpleasant odor, the sulphur mushroom is good eating when finely cut, slowly stewed, well buttered and seasoned and served after milk has been added with a little thickening. It is delicious when broiled. The sulfur mushroom is particularly commendable and worthy of note because of its common occurrence.

The most frequent mushroom inhabitant of our lawns is the shaggy-mane ink-cap. The plants here illustrated grew in rank profusion upon the lawn in front of the writer's home. They are especially plentiful in the wake of autumn rains. The possessor of such a lawn is fortunate, indeed, because the shaggy-mane is considered one of the most toothsome of all our



Morel or sponge mushroom. The pitted head is characteristic

Coral mushroom. A single plant removed from the mass

Sulfur mushroom. The plant shown here was over three feet in diameter

mushrooms. On account of their delicious flavor and easy digestibility, they are prime favorites for invalids and sufferers from indigestion.

The shaggy mane is frequently a stately and beautiful plant, its white head and egg-shaped outline presenting a conspicuous but attractive appearance when set off by the green background of the lawn. It also frequents gardens, barnyards and especially any locality where ashes have been deposited. The head is shaggy, hence the common name, with the scales sometimes tipped with purplish-black, but more often the entire head is white or slightly brownish-yellow. For esculent purposes, the plants should be gathered while young when the interior is perfectly white, since at the approach of maturity the head opens up and the spores turn black, rendering the plant unpalatable. These blackened spores drip from the expanded head in the form of sparkling drops, a habit responsible for the name inky-cap. The adult plant is usually about three or four inches high, although specimens seven or eight inches high are by no means rare. The cultivation of the shaggy mane is rendered impractical on account of its poor keeping qualities, since it is succulent and readily perishable. Even very young specimens will continue to expand after plucking; for this reason prompt cooking is recommended or the entire collection may be spoiled by the ink-spattering habit of those which have thus matured unaware to the collector. The value of the shaggy mane is further enhanced by its unique appearance which is totally unlike that of any poisonous mushroom.

The old-world fungus which is so eagerly sought by foreigners is the beefsteak fungus, a blood-red, hairy and fleshy mushroom, growing sometimes abundantly on the decaying and fallen trunks of the oak and chestnut, The appalling catastrophe to all our chestnuts caused by the ravages of the chestnut blight should insure a heavy crop of the beefsteak fungus for several years to come. The statement is made by Captain Charles McIlvaine that this fungus was so abundant at Mt Gretna one summer that a hundred pounds of it could be gathered almost any day. The beefsteak fungus should be thoroughly cooked and the acid flavor removed during the cooking process by the addition of sodium carbonate. The vivid red color makes this a most handsome and attractive plant, an attractiveness which is decidedly enhanced upon tasting. When properly prepared, this fungus is superior in flavor to most kinds of meat; hence the common name, beefsteak fungus, is well chosen.

Extreme care has been exercised in this article to mention only the mushrooms which are common and offer gastronomic possibilities, but are not likely to be confused with the dangerous poisonous forms. Any writer upon this subject undertakes a delicate task of extreme responsibility, but fully realizing the difficulties, the present writer feels safe in submitting a consideration of these characteristic edible mushrooms to the amateur mycophagist.

A broader knowledge and more intimate acquaintance with the mushrooms will do much to solve the high cost of living problem. Many millions of these sources of delicious foods annually go to waste in our woods and fields because of lack of knowledge regarding their utility. The mushrooms are not only nourishing, but in addition offer a variety to our daily diet that is excellent, cheap and satisfying. They could, and should, be eaten far more generally than they are at present.

Giant casting for a gyroscopic stabilizer 10 feet in diameter and 27 inches thick; weight 55,000 pounds

Large Steel Castings to Prevent Ships from Rolling

A SMOOTH voyage across the Atlantic is believed to be a coming possibility no matter what the weather or the size of the waves. This much desired accomplishment will come about by the use of what are known as gyroscopic stabilizers. They are, briefly, a rapidly revolving solid body which keeps the vessel in equilibrium. The new principle has been applied to some of the smallest yachts and to aeroplanes and is now being extended to larger ships.

The illustration shows the largest steel casting for this new use ever made. It is 10 feet in diameter and 27 inches thick on its face. It weighs 55,000 pounds or 27.5 tons. A United States Army transport has been equipped with two of these.

The application of such castings in gyroscopic stabilizers depends for its success on the fact that when revolving at a high rate of speed, the usual motion imparted to a vessel by the waves is neutralized or offset by this revolving mass. This remarkable result is accomplished if the gyroscopic wheel is at least one per cent in weight of the ship's displacement in tonnage. This particular casting, installed in the army transport, will revolve 1150 times per minute—a wonderful speed for so large a mass.

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Human spiders at work on the smokestacks of New York's giant steam plant, 325 feet above the street

The top member of one of the twelve-foot smokestacks of New York's latest central steam-heating plant, being hauled through the streets

Tanks, partly full of water and called damping tanks, constituted the first attempt in the 1880's to stabilize or to prevent the rolling of ships. They were placed on English battleships by Sir Philip Watts. Later Sir John Thomycroft, an Englishman, used a large weight as a stabilizer, equal to about five per cent of the ship's displacement. Recently Herr Frahm again invented damping tanks made in the shape of horseshoes, but Dr. Schlick, a German engineer, first used a gyroscope as a stabilizer for ships. It was a large wheel, mounted horizontally in the ship, and so located as to swing freely, with its shaft vertical. All these devices were faily successful against heavy rolling, but not against moderate motion of the ship. This new American device invented by an American engineer, is so sensitive that it is as easy to make a vessel roll as to prevent the slightest rolling.

One of the smaller gyroscopes now successfully being used is installed on a small steam yacht owned in Cleveland. The weight of this casting with its shaft and armature is only 2,150 pounds and it revolves at 2,750 revolutions per minute. The casting is 3 feet in diameter and 10 inches wide on its face. The smallest gyro-rotor now in use is on speed motor-boats which travel at a rate of 37 miles per hour. It is 24½ inches in diameter, weighs 550 pounds and travels at the remarkable speed of 5,000 revolutions per minute.

The United States Government has been making very successful experiments with this device. It has employed it satisfactorily on the United States destroyer, "Worden," and the results there led to the introduction of this very large one on the army transport. It is stated that no doubt in the near future these stabilizers will be installed on the largest battleships. If so, castings for this purpose will make the one here shown look quite insignificant in comparison.

The field is a wide and growing one. Submarines are to use stabilizers and numerous acroplanes have been fitted up with them so as to render the plane so nearly automatic that the pilot need only watch the direction of his flight.

Doing Away with the Individual Steam Boiler in New York City

ALONG with electricity and gas, many business men in New York's financial district have found it more satisfactory to purchase their steam supply from a central station. So, in many buildings, the individual boiler is done away with; and in its place one finds a simple valve mechanism for turning on the high-pressure steam from the supply mains under the street, and a meter which measures the volume of steam consumed. In this manner the occupants of the building have available at any moment all the steam they may require for heating and power purposes—and they only pay for the steam they actually use. The advantages of a central steam supply are immediately obvious to anyone, hence no lengthy discussion is necessary

No better proof of New York's endorsement of the central steam plant idea could possibly be presented than the new power plant now being erected in the downtown section, overlooking the East River and Brooklyn. To take care of its steadily increasing business, a steam supply company has been obliged to add this new plant to its system. The building proper towers 150 feet above the sidewalk, and while it is as high as the average ten-story building, it contains but four floors which are devoted to the manufacturing of steam on a wholesale basis. Six smokestacks, each 175 feet above the roof or 325 feet above the sidewalk, complete the steam plant. Each smokestack is 12 feet in diameter.

In all, the new steam plant will generate 27,000 horsepower of steam energy, which will be distributed through mains laid below the streets, at a pressure of 100 pounds per square inch, to the various consumers in the financial district. The plant, which is said to represent an investment of $1,500,000, will require 900 tons of coal each day to heat the water for the steam. The six black smokestacks of the new steam plant add a fantastic touch indeed to the sky-line of lower New York.

Strategic Moves of the War—April 5th, 1917

By Our Military Expert

FIGHTING all along the "Hindenburg" line from Arras to Vailly and beyond has taken place, the advance of the British and French continuing. True, it has been by slow degrees; but it is an advance nevertheless. It is as yet too soon to say whether the retreat of the Germans has reached the base already selected and it is still a question whether the Allies are facing the permanent Hindenburg line. A careful survey of the existing war maps would not indicate that the British had yet reached the natural German line of defense.

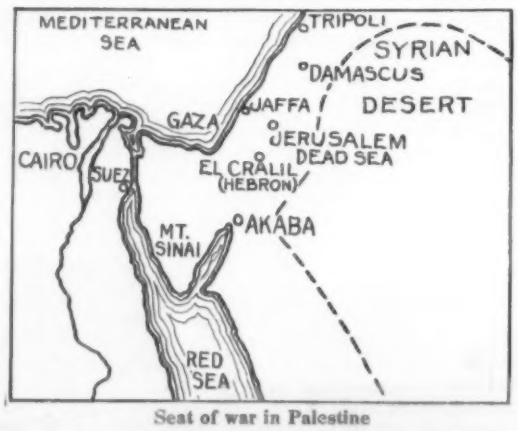
From Arras to the south of St. Quentin and on to LaFère, the present fighting lines run without any reference to natural formations or to permanent roads. Since 1914, it can be said that trench fighting has destroyed pre-conceived ideas of the effect of terrain on military operations for the opposing armies have run their lines irrespective of hills, valleys, rivers, slopes or railways. They have dug trenches through swamps and have fought battles from trenches on the slopes of hills. They have had lines up to the banks on both sides of rivers, have built roads and narrow and broad gage railroads and, in fact, have been stopped by nothing as regards the physical conformation of ground for offense and defense. All these considerations belie previous discussions on the values of commanding ridges and hills and of commanded low grounds, crossfires and projecting salients. As with so many other theories, prophecies, and foregone conclusions, during this gigantic war extending over the world at large, even the long established rules regarding the effects of the physical conformation of the ground on the tactical problems of the battlefield seem to require readjustment and adaptation to present conditions.

So far as present developments would show, the withdrawal of the Germans from the Somme would indicate not so much a desire for any open battle in the field as to avoid the terrific drive of the English-French Army with its tremendous superiority of artillery. It was evidently expected that a rapid offensive could not be made in view of the time necessary to bring up the heavy guns, an expectation that so far has been disappointed. For the Allies appear not to have lost a day or an hour, but have kept up a constant pressure night and day that is rapidly telling upon the German morale.

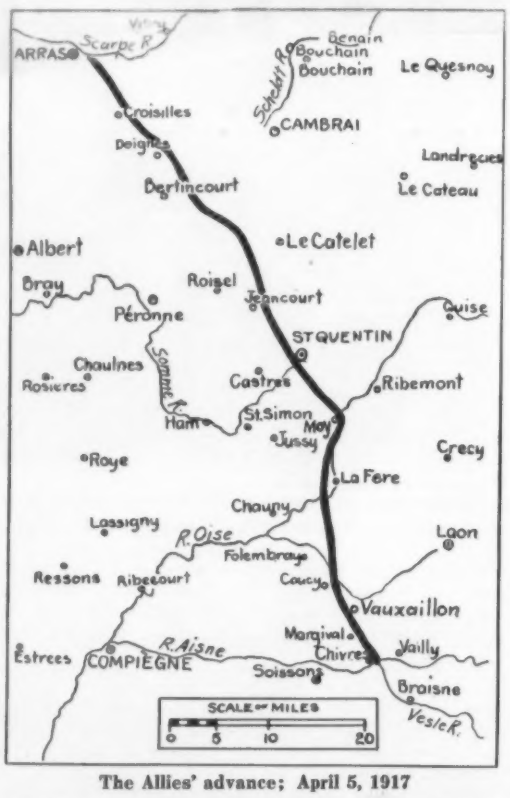
By the capture of Selency and Holnon wood and village, two miles from the town, the British have gained a footing on the ridge that overlooks St. Quentin lying in a depression below. If they can continue to hold this position, the city must be given up by the Germans. North of Selency lies the village of Fayet from which, if once taken, the British guns will command the only road running out of St. Quentin not yet within artillery range. North of the road leading from Bapaume to Cambrai, the British also gained important successes, capturing Croiselles with a number of villages around it. At one point in the high road to Cambrai they are only eight miles from that town, with a gently rolling country between that offers no very great obstacles to a successful advance. South of St. Quentin the French still hold the Essigny-Bena heights with the Germans apparently in strong force in front of them. The latest telegraphic reports state that the French have not only captured additional villages on the Oise front including Moy-Sur-Oise but that their soldiers are even now in the outskirts of St. Quentin. The Hindenburg line of defense being thus outflanked, the question of its abandonment by the Germans would seem to be now only a matter of hours.

Some advance has also been made on the extreme southeastern extremity of the St. Quentin-Laon line where north of the Aillette and towards the St. Gobain plateau several villages have been taken and held. Some French detachments have pressed forward at Vauxaillon beyond the railroad and have made captures of guns and prisoners. A consideration of the situation at the present time around St. Quentin and Arras points to interesting developments. The capture of Croiselles indicates the abandonment by the Germans of positions around Arras and possibly of the town itself, leading to a retirement to the line from Douai to Cambrai; the pressure around St. Quentin indicates strongly the abandonment of that place. These movements, when considered together indicate a withdrawal from the Hindenburg line. The evacuation of Arras would carry with it that of Lens with the positions on the Vimy ridge so long held and so hotly contested at times. A glance at the map will show that the Germans are now fighting to hold the last eastern slopes of the elevated ground that runs from the English Channel to and through northern France. As has been noted in this article, these slopes are simply hills, separated by water courses, not easily defended like so much of the ground to the south; it is not probable that the Germans will try very long to hold the present line from Arras to the Bapaume-Cambrai highway, and a withdrawal here means a considerable one at other places in the lines.

Between the Bapaume-Cambrai road and St. Quentin, the British have driven forward to within three miles of LeCatelet and to within two miles of St. Quentin, with every road leading from St. Quentin to Cambrai under gun fire—especially since the capture of Maissemy within a few miles northwest of St. Quentin and directly overlooking the highroad to Cambrai. Under such conditions it is but natural that the Germans would withdraw from St. Quentin behind the Scheldt River which, with the Somme, rises on the hills behind LeCatelet; such a movement would bring their lines to the Oise River at Ribemont and thence to Vailly on the Aisne. This would give the full advantage that elevated ground or hills could offer, there would be roads and railroads behind the lines for supply—and, all in all, it would be the most defensible line that could be obtained from Douai south. If the Germans mean to hold the Hindenburg line, Arras-Cambrai-St. Quentin-LaFère-Laon, then the British are quite up to that line from St. Quentin to LeCatelet. In the Laon sector the French are straightening the line that runs from the Oise at Chauny through Coucy-le-Chateau to Vailly on the Aisne. But even here the French are making slow advances and but little now remains to be done to break the German lines along this part of the front. The conclusion cannot be avoided that a much more extended retirement by the Germans is contemplated; at an early date it is believed that the German lines will be found much nearer the Belgian frontier than at present—even as far as pointed out in the last review, *i. e.*, from Armentières through Lille-Valenciennes to Mézières and the line of the Meuse River to Verdun. Such a withdrawal would mean the abandonment of four or five times as much ground as has heretofore been evacuated and would shorten the front by eighty or eighty-five miles.



Seat of war in Palestine



The Allies' advance; April 5, 1917

On the eastern front, the Russian War Minister after a visit to the northern part of the line stated as follows:

"No serious activity may be expected on this front in the near future. The melting snows which render the roads and rivers impassable preclude any big operations." This statement was made to allay the fear that has been raised by the earlier warning that Petrograd itself was menaced by a threatened German attack and is in accord also with the views of those who know northwestern Russia and its physical features. The spring thaws in that region would deprive any offensive movement of prospects of success. Even had the Germans attempted an advance, it is now and will be for some time impracticable to move either artillery or supplies for, in that marsh section of Russia, all transport would be mired from the start. There have been some skirmishes around Dvinsk, the Oginski Canal, Brzezany and Stanislau, southeast of Lemberg. The most recent accounts report an advance in force by the Germans across the Stockhod River about thirty-five miles northeast of Kovel. Here the Russians were driven back and a crossing made from the west to the east bank of the river at the Helenin station where the Russians had established munition depots. This move puts a wedge into the Brussiloff lines that were established in last summer's operations. Fighting continues to grow heavier on the eastern front as spring opens and, consequently news of interest can be soon expected from the front around Lemberg and to the south into Rumania.

In Palestine there have been most important and far-reaching military operations, the ultimate object and effect of which will be seen later. On March 7th the British captured El Khalil (Hebron) about forty miles from Jerusalem and about thirty-five miles inland from the Dead Sea. Evidently these troops remained here while the left wing of the army advanced along the Mediterranean coast, laying railroad tracks for supplies from Egypt to the southwest and covering this work as progress was made. On March 27th, at Wadi Ghazzeh near the ancient city of Gaza, this left wing gained a complete victory over a Turkish army of 20,000 men, capturing the Turkish general and his entire divisional staff together with 900 men.

The capture is reported of Austrian and German officers serving with the Turks, also of Austrian guns. The total loss of the killed, wounded and missing of the Turkish forces is given by the British commanding officer as about 8,000 men, his own loss being very much smaller. The victory appears to have been a decisive one and must have ended in the retreat of the escaping Turks upon Gaza and possibly upon Joppa, the port of Jerusalem forty miles north. It is doubtful whether the British can follow up very rapidly their success, as the lack of water is repeatedly mentioned in official dispatches and it will, of course, be necessary to complete the railway along the seacoast as the column advances. However, this army can also be supplied from the sea, as the road north to Joppa lies near the coast. There is a good railroad from Joppa to Jerusalem and the left and right wings of the army, moving forward to the latter city, would parallel the line of the railroad. The Turkish troops opposing these columns, having had two stunning defeats, are not expected to offer any strong defense of Jerusalem.

The objective of the British advance in Palestine is now seen to be the seacoast ports and Jerusalem instead of a drive against the Damascus-Mecca railroad as has been surmised. It is evident, as mentioned in the review some weeks ago, that this movement is in coördination with the operations in Armenia and Mesopotamia. The object is to put pressure upon the Turkish armies in all directions in those countries, possible ultimately to join hands for combined operations against Constantinople from the east.

As regards Mesopotamia, the British troops are undoubtedly advancing, though in a measure awaiting the junction with the Russians coming from Persia. The problems of supply and transport are perhaps much less than during that part of the campaign ending in the capture of Kut-el-Amara and Bagdad, though still very serious. It is understood the British constructed a railroad from Busra to Kut and possibly extended it to Bagdad and to the north along the Tigris. The result of the military operations there may be the construction of the eastern end of the original Bagdad railway far in advance of the date at which it would have been completed if there had been no war. The latest advices state that Russian troops are advancing from Kerind to Khanikin on the Mesopotamian border and are driving the Turks before them toward the Diala River and the Tigris. A more northerly column of Russians has crossed the border from Baneh and are holding their own against strong Turkish resistance. The object of the combined movements of the Allied troops from the northeast, east, southeast and south is evidently to round up and capture the demoralized Turkish forces now scattered at various places east of the Tigris and south of Mosul, an operation that seems to have every prospect of success. With the capture of these troops, all armed resistance to the Russians and British in Mesopotamia will end and these forces will then be able to operate in Armenia.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The German Grain Supply

To the Editor of the SCIENTIFIC AMERICAN:

As a reader of your esteemed journal, may I ask the courtesy of extending me space for a little comment on Mr. Albert K. Dawson's article in your issue of the 27th January on "Economic Conditions in Germany."

At the bottom of the first column of the article it says, on the authority of Herr Direktor Meyer, that in 1913 Germany exported over 2,000,000 tons of grain and grain products in excess of her imports, this, consequently, being the quantity produced in Germany over and above her own needs. The same authority also states that Germany sends her rye crops to Russia.

It seems that Mr. Dawson has accepted these statements without any verification whatsoever. This is all the more surprising because it is quite common knowledge among the initiated both in Europe and in America that Germany herself never produced enough cereals to satisfy her own demands, and, moreover, that Russia is one of the largest grain raising and grain exporting countries in the world—hence could never be a field for any surplus of cereals of other countries.

I will substantiate this by figures, taken not from statistics of countries hostile to Germany, but from her own year-book treating on the matter of her foreign trade. In the Official German publication, under the title *"Statistick des Deutschen Reiches, Auswärtiger Handel im Jahre 1913, Heft III, Band 270—III. Gesamteigenhandel des Deutschen Wirtschaftsgebietes im Jahre 1913 nach Waren gruppen. Bearbeitet im Kaiserlichen Statistischen Amte"* we are told that under caption "A," comprising all direct products of agriculture, the German imports were 14,307,544,500 kilograms, valued at 3,946,889,000 marks, against exports of 3,822,530,900 kilograms, worth 979,737,000 marks; and that under caption "D" embodying all agricultural by-products, imports were 3,421,107,500 kilograms, of 519,590,000 marks value, while exports totalled 2,657,883,500 kilograms, or 659,348,000 marks. Caption "A," it may be remarked, includes all grain shipment, seeds, vegetables, etc., but the major part naturally is grain. Caption "D" includes flour and all other secondary products. It is plain, then, that Germany's agricultural imports were 17,729,000 metric tons* of 2,204 pounds, her exports 6,480,000 tons, the excess of imports 11,248,000 tons.

If we analyze these figures more closely, confining ourselves to grain, we find imports of 8,334,581 tons, exports of 2,570,566 tons, excess of imports being here 5,764,015 tons. And as for the assertion that Germany exported her rye crops to Russia, the statistics before us show that she imported from Russia 313,583 tons of rye and exported to Russia 231,253 tons, leaving an import balance of 82,330 tons. The exports of rye to Russia can be explained by the vastness of the Russian territory, so that in some instances Germany found it profitable to import Russian rye from provinces near her borders, and with a change in the grain market to export the same rye back to Russia by water. Some cause for it may, doubtless, also be found in the former German-Russian Commercial Treaty and the liberal Russian Customhouse Tariffs, by dint of which up to May, 1914, shipments of grain from Germany were allowed to pass duty-free. However, in any event, it is clear that Germany imported more rye from Russia than she exported to that country. Therefore, the statement in Mr. Dawson's article to the effect that Germany disposed of her rye crop in Russia does not hold out a proof.

Again, the total trade between Russia and Germany under captions "A" and "D" for 1913 shows that Russia shipped to Germany 5,575,124 metric tons, valued at 761,756,000 marks, receiving in return but 360,059 tons worth 82,782,000 marks. Subtraction here seems superfluous.

The above summaries clearly evidence the fact that Germany not only never had any surplus in cereals, but that she actually is dependent upon other countries for the maintenance of her supplies in foodstuffs. Further, that during the year 1913 this shortage in cereals reached the huge amount of 11,248,238 tons, of which about fifty per cent she covered out of imports from Russia.

In addition to cereals Germany likewise imports vast amounts of other foodstuffs and, if these are taken into consideration, her shortage in foodstuffs generally will be augmented to approximately 20,000,000 tons.

All of this, as said in the beginning, will not be a surprise to the majority of people both here and on the other side of the ocean, but it will perhaps serve to prove to some extent that statements like the one made by "Herr Direktor Meyer" should be taken with a grain of salt generally and not accepted for "gospel" as did Mr. Dawson.

As many Americans in Entente countries have frequently remarked on the laxity of these nations in giving publicity in America to the truth of the Allied cause, I have ventured to ask your indulgence by kindly giving space to this letter, for the sake of truth, for truth only is science.

Yours respectfully,

I. CAOUL.

[The editor is indebted to Mr. Caoul for the above statement. Mr. Dawson states that he quoted Herr Meyer correctly, and that accordingly the only comment he can make is that any misstatement made in his article is Herr Meyer's, and not his. The editor passes the comment along to his readers, with the remark that Mr. Caoul has quoted his official German source correctly. It is to be regretted that existing conditions make it impossible to seek Herr Meyer's source of information and track the discrepancy to its lair.—THE EDITOR.]

*One metric ton = 1,000 kilograms = 2,204 pounds.

Universal Disarmament Again!

To the Editor of the SCIENTIFIC AMERICAN:

To befog the paramount issue of universal disarmament with discussions as to the lacks of pacificists were lackadaisical indeed. I quite concur with your correspondent, Mr. Gregg, in his assertion that "the hearty desire for peace" has "extended the world over." But the fact remains that while the most powerful fleets in the world, and the most powerful armies in the world, have entirely failed to insure peace, Monroe's new plan of disarmament on our northern frontier has wholly succeeded.

He, too, may have "lacked imagination." But, in urging his new American policy on Great Britain, when Adams, our Minister in London, told him it was "apparently hopeless" to obtain British assent, he used a few phrases well worth remembering.

Adams had advised him of Britain's interest to continue the old European system of militarism, and to crowd more war vessels on the Great Lakes. Monroe's views, as written in reply, were that in following that course there would be, for both parties, "vast expense incurred," and "the danger of collision increased"; while the rivalry in armaments would prove "a continual stimulus to suspicion and ill-will." He further insisted that "the moral and political tendency of such a system (European militarism) must be to WAR and NOT to PEACE."

Perhaps come conclusions of the German philosopher, Nietzsche, may also interest your readers.

"The so-called armed peace that prevails at present in all countries is a sign of a bellicose disposition, of a disposition that trusts neither itself nor its neighbor; and partly from hate, partly from fear, refuses to lay down its weapons.

"Our liberal representatives of the people, as is well known, have not the time for reflection on the nature of humanity, or else they would know that they are working in vain when they work for "a gradual diminution" of the military burdens. On the contrary, when the distress of these burdens is greatest, the sort of God who alone can help here will be nearest.

"The tree of military glory can only be destroyed at one swoop, with one stroke of lightning."

The present world war possibly may prove the "one swoop."

EDWARD BERWICK.

Pacific Grove, Cal.

Entrance To Sound Unprotected

To the Editor of the SCIENTIFIC AMERICAN:

If you have any influence with the powers that be in Washington, possibly you could bring to their attention the fact that there is absolutely nothing to prevent a foreign submarine coming through Long Island Sound, where a half dozen shots from a moderate-sized gun could put the bridges on the New Haven Railroad out of commission. Three or four guards now patrol each bridge, which would hardly prevent this, as the submarine would be three miles off shore. A couple of 6-inch guns placed to cover each bridge from the Sound side, would seem to be a little better.

This is just a thought for better protection of the main line of communications in the East.

CONSTANT READER.

Bridgeport, Conn., March 10, 1917.

Mellish's Comet

To the Editor of the SCIENTIFIC AMERICAN:

According to an orbit computed at the University of California, Mellish's comet will reach perihelion on April 12, at the unusually small distance of 15 million miles. When discovered, it was on the farther side of the sun, about 80 million miles from sun and 130 million from us, and it should grow rapidly brighter as it approaches both and become conspicuous to the naked eye. At the beginning of April it will be near the star of Arietis, and moving slowly westward. Until the 11th it will be visible in the evening at first after the twilight is well advanced, later only on a strongly illuminated sky. Between the 11th and 15th it should be seen before sunrise—probably not the head, for that will be within 10° from sun, but the tail, which, judging from previous comets of small perihelion distance, is likely to be conspicuous.

HENRY NORRIS RUSSELL, Ph.D.

Princeton, N. J., March 29, 1917.

Nitrogen Fixation An Accomplished Fact

AT the recent annual meeting of the Institute of Chemical Engineers in New York, Prof. John E. Bucher of Brown University spoke upon the fixation of nitrogen, which means the getting of nitrogen from the air into chemical combination, so that it may be used for the production of fertilizers, explosives, munitions of war, dyestuffs and in the chemical industries generally. There has been so much written and said on this subject that many of the sophisticated members of the Institute considered it not worth their while to come to hear Prof. Bucher's contribution; but those who did come heard a most absorbing account of what bids fair to lead to a chemical revolution of the first magnitude. At a later date Prof. Bucher gave an address at the College of the City of New York, describing his experiments and processes in some fullness. This we reproduced in the SCIENTIFIC AMERICAN SUPPLEMENT of April 7th; but the subject is of such vast consequence that we here put it before those of our readers who do not see the SUPPLEMENT.

By way of explanation it may be said that the industry of fixing nitrogen began at Niagara Falls twenty years ago, in the effort to carry out the inventions of an American chemist, Charles S. Bradley. Lack of financial backing led the industry to drift over to Norway, where it now flourishes to a moderate degree, in spite of its enormous requirements in electric power. A German process, worked out to meet this objection, has not come into wide use because, in spite of the reduced power demand, it is still inordinately expensive. Germany to a large extent, and all other first-class powers exclusively, buy their nitrogen from Chile in the form of nitrate of soda. But when, some day, this supply gives out, it will not be possible for agriculture to thrive or munitions of war to be made without fixed nitrogen. Hence the extreme importance of the subject of fixation, and the great amount of attention it has received.

Dr. Bucher has done away with the necessity for electric power in fixation by finding strictly chemical means for making the air give up the nitrogen to which it clings so tenaciously. The substance of his discovery is that nitrogen will combine with an alkali and carbon in the presence of iron as a catalyst, producing the cyanide. Reduced to concrete terms, this means that he mixes soda ash and powdered iron or iron ore—either will do—with powdered coke. Upon heating this mixture in an ordinary furnace and running air over it, the result is cyanide of soda, leaving the iron uncombined. In spite of this fact, that the iron is in the end untouched by the action, if it be omitted no action takes place. It acts as a sort of chemical parson to combine the nitrogen of the air with the soda and the coke. No electric power is needed, no heavy outlay, no costly materials; the whole thing may apparently be carried out anywhere at very low cost.

It would seem that this finished the matter; for sodium cyanide, by treatment with steam, will pass into bicarbonate of soda and ammonia, and the latter is fixed nitrogen, capable of conversion into nitric acid or fertilizer or any one of a thousand other things. But Dr. Bucher went even further. He let into the cyanide of soda solution some waste carbon dioxide gas from his furnace, thus producing urea. This is three times as rich in nitrogen as the soda nitrate, twice as rich as ammonium sulphate; and both of these are used profitably by farmers. Moreover, urea will not make the soil acid and from preliminary tests it bids fair to give surprising results as a fertilizer.

Under influence of the electric current the cyanide can also be separated into metallic sodium and cyanogen. For the former there is always great demand; the latter is readily absorbed by hydrochloric acid to form oxamid. This contains about thirty per cent nitrogen and is almost entirely insoluble. It would therefore not be washed away by rains, and should make another ideal fertilizer. Of course, nobody has ever thought of using urea or oxamid for fertilizer before because they have always been very expensive, but Dr. Bucher's work changes all this and puts them among the cheapest fertilizers.

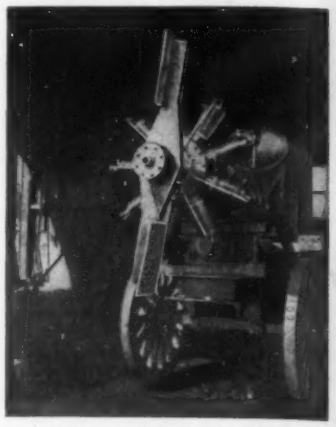
Perhaps the most extraordinary feature is that no single reaction of those employed by Dr. Bucher is securing such results is new. Every chemical fact of which he has taken advantage was already known, and it remained only for some one to have sufficient insight to arrange them side by side in proper order. This done, we have here a way of doing what chemists have been trying to do for forty years, without any other raw material than coal, iron, soda and air, and without the need of water power. There are engineering details yet to be worked out, others that are still unproven in practice; but the idea is there.

A rotary engine undergoing the three-hour test

Bringing the Gnome Engine To America

How This Most Intricate of Aviation Engines Is Being Successfully Manufactured In Our Country

By Austin C. Lescarboura



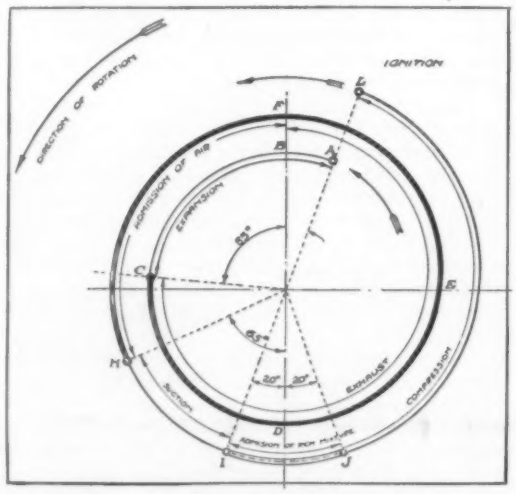
A rotary engine fitted with the test propeller

IT was on the rolling plain of Betheny, within view of the historic cathedral of Rheims, that the Gnome rotary engine made its debut in the world of aviation. The occasion, which could hardly have been more propitious, was the first international meet—and no doubt the most successful ever held.

Back in those days toward the end of 1909, the aeroplane was still in its infancy. The airmen were skilled and fearless: the personnel was no doubt the equal of that of today. But their mounts were comparatively crude contrivances. Most of all, the fault lay with the engines, which were unreliable to say the least. A mechanician at that time spent the greater part of his time tuning engines, coaxing them, as it were, to do their duty when the time came for a prize-winning flight. Balky at the start and balky during flight, like the proverbial mule the engines as often as not quit work when the pilots were within easy grasp of victory. With these conditions as a background one dominant engine came through the Rheims meet; the engine based on an entirely different principle; an engine which proved its reliability in flight after flight: the Gnome. It will be remembered by the student of aviation that Farman won his spurs at that meet with his Gnome-engined Farman biplane; and Paulhan, too, came in for his share of recognition riding in his Gnome-engined Voisin biplane. A year later the Gnome scored the greatest successes in the international meet held at Belmont Park, Long Island, where the European aviators came in order to compete for the Gordon-Bennett cup which that pioneer American airman, Glenn H. Curtiss, had brought back to our country as a result of his plucky flight at the Rheims meet. In every part of the world where men flew, the new rotary engine had established itself in the dominant position among aeronautic engines.

For years the Gnome maintained its lead; but with the demand for heavier, faster military aeroplanes the call came for more powerful engines. Whereas 50, 75 and even 100 horse-power had been considered ample in the earlier aircraft, the ever-increasing dimensions of the later-day aeroplanes brought forth engines of 100, 150, 200 and even 300 horse-power. But owing to its mechanical peculiarities, the Gnome engine is not adapted to these higher powers; hence it had to make way for the stationary-type engine in the heavy aircraft. Meanwhile the designers and builders of the stationary-type engines had succeeded in greatly improving their products until they showed a reliability not far behind that of the Gnome, and in many instances duplicated the performance of the rotary.

After close on to three years of war, during which aviation has made tremendous strides, we find the Gnome engine used almost exclusively in scout and pursuit planes, in which field it apparently has no competitor;



Diagrammatic explanation of the operation of the nine-cylinder Gnome engine

while the heavier reconnaissance and bombing planes are provided with the excellent stationary-type engines of the hour.

An Engine With a Stationary Shaft and Rotating Cylinders

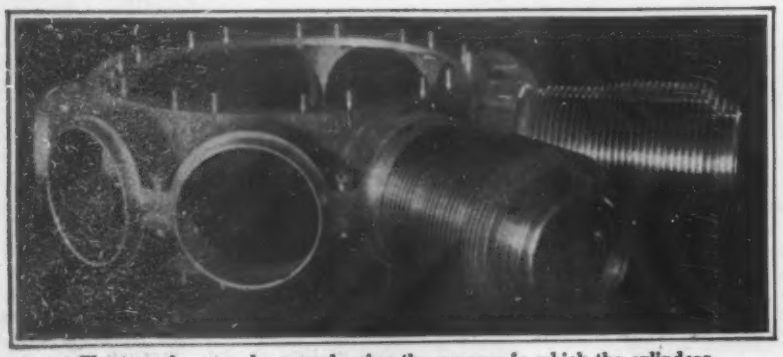
The Gnome rotary engine originated in France and mechanically it is considered one of the most beautiful, if intricate, of all aeronautic engines. At the time of its introduction this engine was looked upon as a triumph for the French mechanics, for its construction calls for the greatest skill and accuracy. The early type was rated at 50 horse-power, and had seven cylinders which, contrary to the usual practice in engine construction, were made to rotate while the crankshaft remained stationary. It is this fly-wheel action that gives to the Gnome engine its remarkable reliability. The shaft being hollow, the explosive charge and the lubrication pipes are passed through it to the crank case and the cylinders.

The most popular type of Gnome engine at present is the monosoupape or single valve, which works on the four-stroke cycle. By referring to the accompanying line drawing the cycle of operations can be followed readily. Considering a cylinder in which the piston is on the compression stroke and following the engine through two revolutions, it will be noted that the ignition, which is fixed, takes place 15 to 20 degrees before the top dead center or *A*. Following the ignition of the charge the piston descends on the power or working stroke, represented by the arc *B C*. After the cylinder has turned through 85 degrees from the top center, the single valve opens and exhausts the products of combustion beginning at the point *C*, which process continues until the piston returns to the top dead center, or after traveling through *C D E F*. The piston then descends on the induction stroke while the exhaust valve still remains open, and through the latter draws air into the cylinder. The valve closes 65 degrees from the bottom center *H*, and as the piston continues to descend a partial vacuum is created in the cylinder until it is 20 degrees from the bottom center *I*. At this stage the piston uncovers the ports in the cylinder wall, thus opening a passage between the cylinder and the crankcase through which is drawn a very rich gasoline mixture. This mixture is diluted by the air already in the cylinder, forming an excellent combustible gas. The ports in the cylinder wall remain uncovered until the piston reaches the point *J* on the return stroke, when they are closed as the piston ascends on the compression stroke. When the cylinder is 20 degrees from the top center *L*, ignition occurs and the cycle of operations is repeated. This diagrammatic presentation of the operation of a Gnome nine-cylinder engine, it may be stated here, is an average from a number of tests, and it should be borne in mind that the figures may vary slightly for different engines.

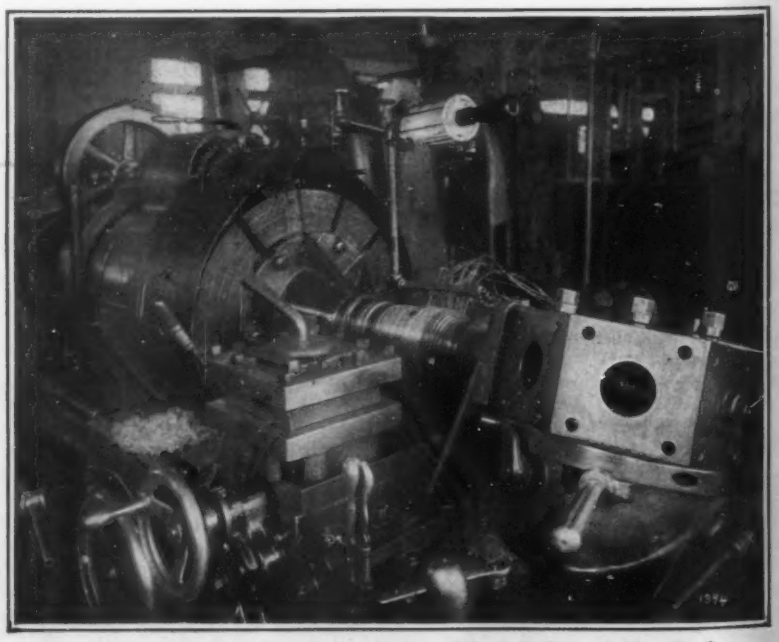
How the Gnome Engine Came to America—and How it Fared

For several years the Gnome engine had been manufactured in England by a company operating under a license granted by the original French builders, but upon the outbreak of the present war the British engine makers

The evolution of the Gnome engine cylinders from forging to finished product—83 to 5½ pounds



The two-piece crank case, showing the manner in which the cylinders are held in position



One of the thirty operations in the turning of the cylinders: cutting the fins on a heavy-duty lathe

found themselves veritably buried under an avalanche of orders calling for Gnome engines for the British air fleet. So, quite naturally, this company sought assistance in the United States, although it was rather dubious of finding a machine shop which could successfully undertake the manufacture of this most intricate mechanism. And although the most exacting specifications were shown to one American concern which offered to undertake the work, and although the difficulties of meeting the British government tests were fully outlined in advance, American confidence could not be shaken, and an agreement was entered into between the British and the American concern whereby the latter secured the rights to build and sell the Gnome and the LeRhone engines.

Think of producing an aeroplane engine which will give one horse-power for every 2.7 pounds of weight and you will have some idea of the fine alloy steels necessary to start with. The selection of the proper materials alone consumed over half a year before orders for these were placed, and even today, after manufacturing scores of such engines which have passed the most trying acceptance tests, the American manufacturer maintains a staff of metallurgists whose duty it is to test every forging. Indeed, shell production is said to be child's play in most cases compared to the manufacture of successful aviation engines of the rotary type—and this organization has undertaken both.

That the manufacture of the Gnome engine has been a successful enterprise in America is attested to by the fact that the manufacturer in Long Island City has already shipped 250 to Great Britain, and at the present moment is starting work on 100 for our Army and Navy. This is reported to be a direct result of the inspection of these engines in this country before use, and the checking up of their performance on the other side, by the U. S. Government officials.

The American-built Gnome engine is of the mono-soupape design, with nine cylinders of 4.3-inch bore by 5.9-inch stroke. Each cylinder is machined from a drop forging which in its original form weighs 88 pounds, while the finished cylinder weighs 5½ pounds. By referring to one of the accompanying illustrations it will be noted that the machining of each cylinder is carried on in progressive steps, starting with the rough turning, then the shaping, followed by the cutting of the fins thinner and thinner until they are hardly thicker than a piece of heavy paper. Something like thirty operations are necessary in converting the rough drop forging into the finished cylinder. To complicate matters still further, the design calls for a number of circular ports which are drilled near the bottom, as well as a threaded plug for the spark plug, which is welded in place after the cylinder is turned.

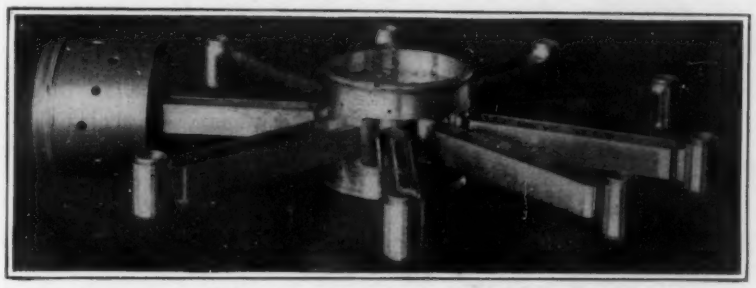
The crank-case, too, is a tribute to the American machinist, and it is doubtful if there is a finer piece of workmanship in any engine made in the United States today. This member is made in two pieces which fasten together by bolts. The halves of the crank-case clasp the cylinders at their base, as shown in one of the illustrations, and the cylinders are prevented by keys from turning in their settings in the crank-case. Since there is no chance to shift the cylinders ever so little to bring them into alinement, the shaping of the cylinder holes in the crank-case calls for the greatest accuracy. Another remarkable piece of work is the distribution case which weighs 201 pounds in the rough and in the one-piece finished case, 15½ pounds. The intricate nature of this latter member can be determined by referring to one of the illustrations.

The crank-shaft of the engine, as previously stated, is hollow and made in two parts. The smaller half can be dismantled from the front of the engine, and the rear or large end of the crank-shaft is open to admit air and contains the gasoline jet. The front nose extension is closed. The gasoline, or fuel, is supplied from the tank to a union on the crank-shaft, and from there carried through a copper pipe inside the shaft to the elbow, where the jet projects into the crank-case.

The system of connecting rods is similar to that of the original Gnome engine, being composed of one "mother" or master rod which forms one piece with the hub, and eight smaller rods which are swivelly-attached to the hub. The odd-shaped "mother" rod is an integral piece which, in the rough weighs 21 pounds, and in its finished form 5½ pounds.

One interesting feature of the American-Gnome is the exhaust valve, which, with its seating, is fixed at the extreme outer end of each cylinder. Instead of employing counter-balance weights which are fitted to the rocking arms of the usual Gnome engine, the American builders have adjusted the weight of the valve so that its centrifugal action when the engine is rotating is equal to that of the tappet rod and lever. This greatly simplifies the construction and eliminates one prolific source of rotary engine trouble.

The camshaft, which is attached to the small end of the crank-shaft, turns at half the speed of the engine and in the same direction. It is operated by the usual satellite pinions. The nine cams, weighing a few ounces each, have a tensile strength of 264,000 pounds to the square inch. The entire engine, it may be said here, calls for work within four ten-thousands of an inch.

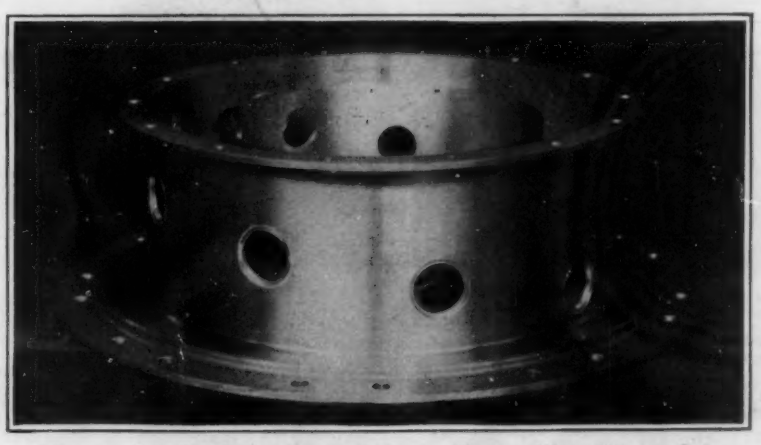


The arrangement of the "mother" rod and the other rods on the hub

After the engine has been completely assembled it is taken down to the yard of the manufacturing plant, where it is given whatever test the purchaser may call for. In the instance of the British Admiralty, the engine is given a three-hour non-stop test, following which it is taken down and the various parts carefully examined for wear or possible damage. If these are found to be in perfect condition, the engine is again assembled and sent to the testing station for a twenty-minute run, which completes the acceptance tests.

The American-built Gnome engine with the front plate removed, showing cam mechanism

In the Long Island City plant the engines are tested in a small wooden building especially built for the purpose. The engine, mounted on a two-wheeled truck, is provided with a paddle-like two-bladed propeller which furnishes the necessary load. The propeller rotates in a sort of a blower box equipped with screens, and the noise of the engine cannot be described in any other way than absolutely deafening. The testers, in order to speak to one another, must shout at the top of the voice into each other's ears, and even then they are often not heard.



The one-piece distribution case made from a blank weighing 201 pounds in the rough, and but 15½ pounds finished

Conservatively rated, the American-Gnome delivers 100 horse-power at a normal speed of 1,200 revolutions per minute. Complete, with its ignition apparatus, it weighs 272 pounds empty. The gasoline consumption per hour is 12 gallons, while the oil consumption is 2.4 gallons.

At a time when we are entering the great conflict which involves over two-thirds of the world's area, it is indeed consoling to know that there is available in this country a plant capable of turning out a rotary aviation engine equal to the best produced by the mechanics of any other country. That this is a tremendous asset in our National preparedness goes without saying.

Seasoning Iron Castings

WE have heard of the seasoning of wood to improve its resistant qualities, but perhaps few know that the same principle applies to iron castings. This little-known characteristic has recently been brought to public notice by Dr. Richard Moldenke, an authority on the metallurgy of the iron foundry. The ability of cast iron to ease up internal strains when allowed to stand at rest for a more or less extended time is important where accuracy in machining is essential. It seems as though the molecules or minute physical units, because of their ability to move, can adjust their relative positions so as to overcome some of the strains which are always present in the metal after casting.

To illustrate the presence of these strains in a casting just after it has been removed from the mold the following case is cited. A very large shear wheel, after shaking out, was put outdoors for cleaning. It was leaned against the building, so that the sun shone upon its upper rim. It soon burst apart with a loud report. The slight strain of expansion in the heat of the sun, added to the stresses already existing in the casting, proved to be the straw that broke the camel's back, going beyond the tensile strength of the material. Had this wheel been kept under cover for a while, at least until machined, the strains in it would have eased off sufficiently to enable the sun to shine upon it without damage. Similar examples are the cases of water hammering in cast iron pipe lines, and the well-known danger of striking an iron fitting that is under steam pressure.

Now it is well known that to get a true piston is most difficult. Even after being ground to an accurate finish it is apt to change and get out of true. If such a piece is allowed to remain in storage for a long time the results will be far more satisfactory. The metal will have seasoned. Where users of such castings can do so, they should order them some time ahead—the longer, the better—so as to store them for seasoning. Of course, in many cases such storing or seasoning is out of the question. This offers opportunity to follow the example of a large automobile maker, who takes one cut off every casting and then carefully anneals the piece, thus removing the internal strains.

The best explanation of the seasoning action is that founded upon the well-known experiments in tumbling castings to increase their strength. It is found that light blows, often repeated, relieve the internal stresses to such an extent that the greatest potential value of the metal is brought out. Replace half an hour's tumbling by six months of quiescence and the molecules will have accomplished the work of readjustment with practically the same results.

More Sulphur From Smelter Gases

By Elwood Hendrick

IN regard to getting the sulphur fumes out of smelter gas, Prof. S. W. Young of the Leland Standford University lately presented to the American Institute of Chemical Engineers a paper on proposed methods whereby the result of the process is crude sulphur. This would indeed be a Godsend. When copper and other ores are smelted they must also be roasted to get the sulphur away from the metal. This is easy enough to do, but the fumes that escape into the air are the fumes of sulphurous acid, and if there is anything that disposes a farmer to carry a pitchfork and a double-bar'l shotgun with him when he goes to make his protest it is these very sulphurous fumes in the air. In fact in some States the laws now forbid the liberation of the gases of burning sulphur in nearly every activity.

It is possible to collect this sulphurous gas and make sulphuric acid out of it, but some plants are so located that transportation costs forbid. Sulphur on the other hand may be stored out of doors as long as desired.

Two methods are known, a wet one and a dry one, but both depend upon the way of sulphur to get out of its combination with oxygen in the presence of certain other bodies.

A Tractor That Ice and Snow Will Not Stall

FREDERICK BURCH and Joseph West, of Grand Rapids, Mich., needed a tractor that ice and snow would not stall. Here is what they designed from ideas of their own, a tractor unique in design and remarkable for the speed maintained while running over ice and snow.

A framework is mounted upon two drums of sheet steel. Upon these, strips of channel iron are supported, which serve as rotary skates. The left hand drum revolves clockwise, while its opposite rotates counter-clockwise. This action is brought about by a familiar arrangement of gears.

Two thousand pounds is the weight of the machine and it skates over the surface of ice and snow at a speed of thirty-five miles per hour. Perfect flexibility is possible as well as a constant propulsion. Its operation is said to be noiseless and motion exceedingly smooth.

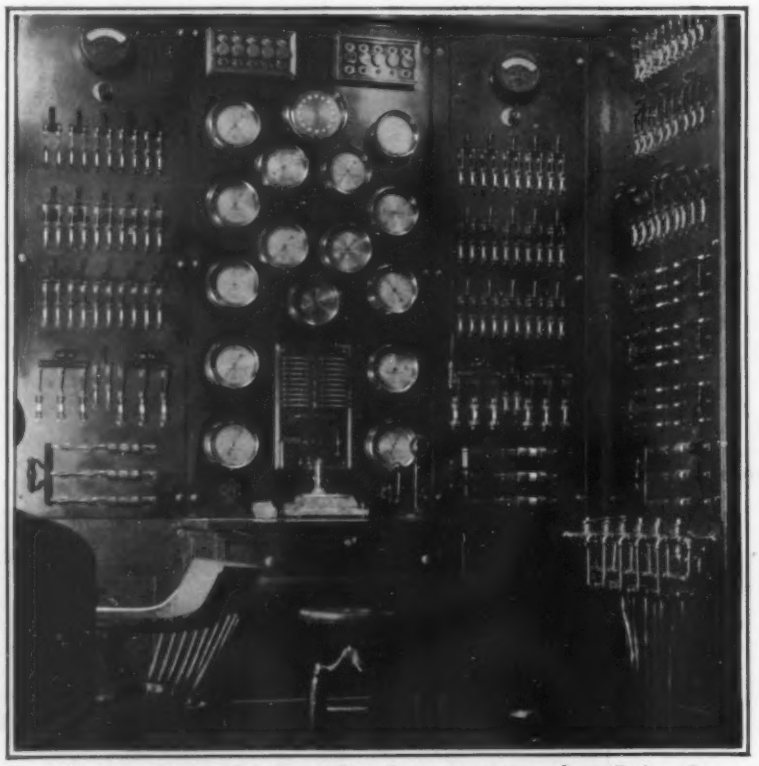
A tractor for snow and ice driven by spiral rotary skates

Electric Control of an Ice Rink

DEVOTEES of ice-skating seldom realize how much attention and labor is bestowed by the management of an indoor rink on the maintenance of the ice. To keep a good skating-surface requires much more than a routine scraping off of the snow, flooding the rink, and keeping the refrigerating plant running. For instance, in Duquesne Garden, Pittsburgh's finest rink, the 90 by 284-foot rink is under constant observation during each skating session by an expert engineer.

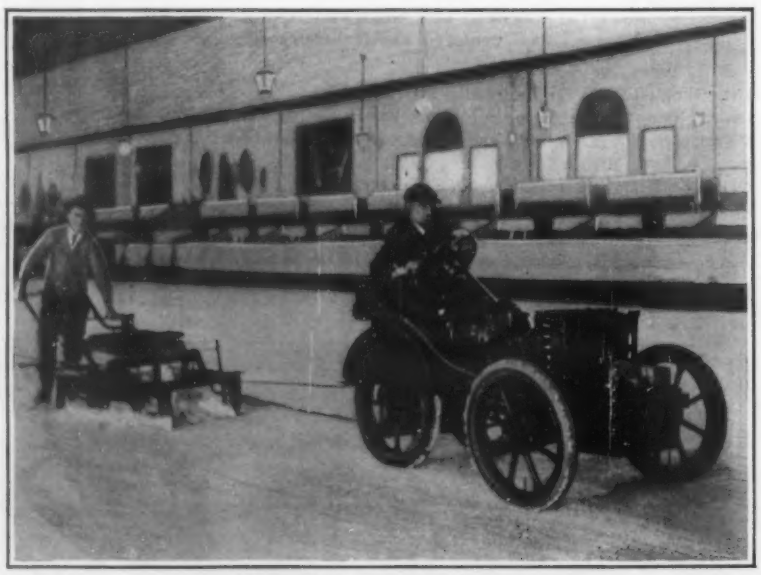
To make the ice in the first place a layer of fine white sand was filled in around and over the rows of refrigerating pipes in the shallow "pond." This was then saturated with water and frozen. Successive layers of water were then sprayed on and frozen so that no "expansion cracks" could form. When the ice-sheet was thick enough, it was shaved off smooth, a final flooding given, and it was ready for use.

Experience has shown that if there is a very thin film on the ice, the skates will slide the more easily. Hence it is necessary to keep the ice surface just at the freezing point. Of course the temperature of the cold brine below it can be controlled readily enough but it is also necessary to keep the air above at a nearly constant temperature. This is done by means of the control apparatus shown in the illustration. On the large panel are gages for the refrigerating system, and at the bottom is an electric pyrometer which reads the temperatures at three points in the rink air, two points in the ice-sheet, and at several other places. The switches on the right hand panel control ventilating fans, and the valves below control large gas heaters. There is a cooling room connected in one air-supply, so that by the use of either heat or cold the temperature in the rink can be held at just the right point.



Elaborate switchboard for controlling the temperature and ventilation of a skating rink

The motor-driven outfit in the second illustration is used to shave off the top of the ice-sheet after each session. The tractor consists of an old automobile chassis with a 10-horse-power motor mounted on it and connected through a chain to the transmission shaft. The tires are steel-studded to grip the ice. Power is furnished through wires inside an armored hose which drops from the ceiling and trails on the ice. The trailer has a veneer-knife blade which can be set to plane off a shaving from the ice, and thus cuts in the surface can be "planed out" so as to give a perfectly solid clean bed for the new ice. After the planer is finished, the ice is wet down and "squeegeed" by rubber-tipped hand scrapers. It is then flooded and frozen for the next session. This system as a whole has been developed by Mr. Dudley H. Scott of Cleveland, Ohio.



Shaving off the top of the ice sheet

A One-Man "Tank" for the Barbed-Wire Cutter

THERE is perhaps no other work in the present European war more dangerous than the cutting of enemy barbed-wire entanglements; indeed, few of the men who volunteer for this service live to tell the tale. Yet the cutting of the opponent's barbed-wire barricade is the first essential to a successful attack, and artillery preparation is not always sufficient to level such obstructions, let alone the fact that it precludes the important element of surprise in the infantry attack that is to follow. In consequence, all the belligerents have tried at one time or another novel schemes for making the work of the wire cutter less hazardous, and among these schemes there have been introduced such innovations as portable shields, breast plates and complete suits of armor, and various types of artillery projectiles designed especially for the destruction of barbed-wire entanglements.

Borrowing their idea from the British "tanks," the French have lately introduced a one-man armored vehicle for the use of wire cutters. This diminutive "tank," which forms the subject of our present cover illustration, appears to be well adapted to its intended work. It consists of a light steel body of a size sufficient to hold a man's body, and is fitted with two wheels. The man's legs project at the rear so that his knees, coming in contact with the ground, furnish the means of locomotion as he crawls along. The head of the tank is cleverly shaped so as to offer a number of slanting surfaces to enemy rifle fire, and, aside from two slits through which the operator can peer, there are two loopholes for either sighting or using a cutter or even a weapon. The hands of the operator can also be passed out under the head of the "tank," as shown. As a further protection the loopholes are provided with pivoted covers which can be turned from the inside.

Ways and Means to Increase American Aircraft Production

THE aircraft manufacturers of the United States had an all-day meeting with the Executive Committee of the National Advisory Committee for Aeronautics in the office of the Advisory Committee in the Munsey Building, Washington, D. C., recently. The meeting was presided over by Dr. Charles D. Walcott, chairman of the Executive Committee. The object of the meeting was to consider ways and means to speed up the Nation's aerial preparedness.

The principal development of the meeting was the appointment of a special committee of seven to arrange details for speeding up production of aircraft and the temporary standardization of types of aircraft to be required by the army and navy. This committee will consist of four members of the National Advisory Committee for Aeronautics and three representatives of the Aircraft Manufacturers' Association.

The prospective needs of the army and navy for the next two or three years were discussed. The apportionment of orders by types to the factories with the best facilities for quantity production, and the standardization of materials used in aircraft were considered. There was discussion of the steps that should be taken by the government to mobilize the important materials that will be necessary in aircraft manufacture, and of the policy of the army and navy in the testing and inspecting of engines, materials and completed aircraft.

There appeared to be strong sentiment in favor of a cross-licensing agreement of aeronautic patents. Mr. Coffin and Mr. Waldon explained the steps in the organization of the National Automobile Chamber of Commerce, and the application of similar measures in the aeronautic industry.

The Current Supplement

THERE is a particularly valuable paper of current interest in the issue of the SCIENTIFIC AMERICAN SUPPLEMENT of Arpil 14th, No. 2154, entitled *Europe at the Door of Turkey*, that discusses historic, geographic and economic data bearing on the future of this much discussed country, which has been the stumbling block of Europe for centuries. It is illustrated by a comprehensive chart. *A Religious Ceremony of the Hopi Indians* describes a curious initiation in Hopiland. *The Metronome in the Workshop* tells of an interesting efficiency experiment and gives a sketch of the apparatus employed. *A Navy Ammunition Depot* gives a few facts about the too modest establishment where powder and shells for our war vessels are stored, and there are several illustrations taken in the plant. *The Silver Voltammeter* discusses a standard instrument for the international measurement of electric current. *Graphic Charts* describes the uses and applications of the latest method of portraying statistical matter by logarithmic scales, and is illustrated by a number of such charts. *The Healing Art* is a most readable paper on the legends, lore and genesis of medicine from the earliest days. Other matters of interest are included in *The Minimum Radiation Visually Perceptible*, *Daylight Savings* and *Analysis of Vocal Sounds Made by Singers*.

The Barrel-Like Home of Tommy Atkins

FOR miles in back of the British front in France there are to be seen hundreds of little houses or shelters which have served Mr. Tommy Atkins to good stead during the winter months. These barrel-like huts are known as Nissen huts, after the British army officer who invented them.

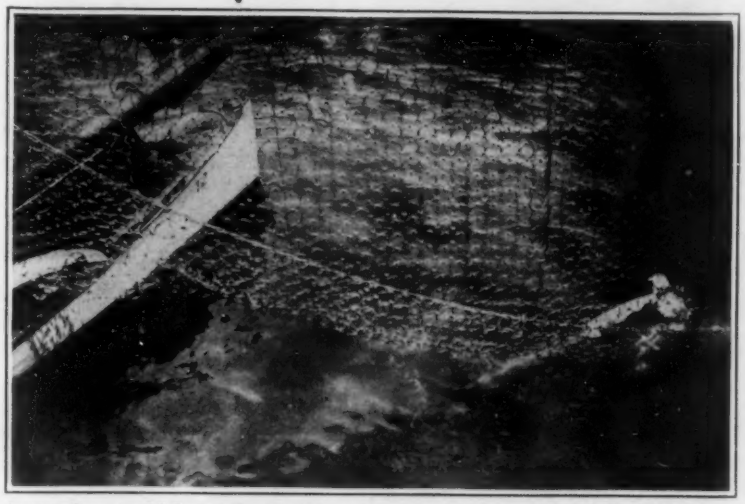
The Nissen huts are galvanized iron structures which are readily put together. The roof members—and the hut is practically all roof—are curved iron plates which are easily carried through the war zone and assembled by the soldiers themselves. Inside, the huts are weather-tight and are kept warm by stoves. The end pieces are provided with conventional windows and doors.

The winter home of the British soldier in France: A colony of Nissen huts

A Torpedo Net and Its Prey

WERE it not for the miles of torpedo netting which Great Britain stretches at the entrance to her harbors as well as at certain points in the English Channel, the ruthless submarine warfare conducted by Germany would no doubt exact a far greater toll in British merchant tonnage; for otherwise there would be nothing to prevent a submarine from creeping up into a harbor at night and torpedoing a number of ships riding at anchor, and then escaping again to the open sea. But with the steel nets in place the submarine is no longer to be feared by ships in port.

No better proof of the efficacy of the torpedo net and the sagacity of netting all American harbors could be found than the accompanying illustration, which shows a British harbor net with a German torpedo which it stopped. The torpedo, in this instance, was prevented from attaining its mark when its propeller became fouled in the meshwork. At the left appears the bow of a British motor patrol boat or submarine chaser, the crew of which are evidently at work raising the net in order to remove its catch.



A torpedo net which guards a harbor entrance "somewhere in the British Isles," and a German torpedo which it stopped

The Bath Tub at the Front

SO perfect are the sanitary arrangements of the leading armies engaged in the European conflict that it may be stated without exaggeration that a soldier at the front can take his bath under almost normal conditions. For instance, he has an individual regulation bath tub at his disposal, and all the hot and cold water necessary. And in many cases there is a shower bath at hand for those who wish to use it. Never has the soldier been so well taken care of as in the present war.

The *roulotte de bains* or traveling bath caravan recently donated to the Belgian army by the Wounded Allies' Committee, is typical of the bathing facilities of the British and French armies. The caravan, it will be noted in the accompanying illustrations, consists of a truck which carries a dozen or more bath tubs and a water heating plant, as well as a roll-up tent. In actual service the bath tubs are taken off the truck and placed on the ground, under the shelter of the tent. Hot and cold water may be brought to the tubs by means of flexible hose, while the bath tubs can be drained in the usual manner through a short length of hose which carries the waste water outside of the tent enclosure.

How the French soldier makes use of the splendid French canals: A canal gunboat in action

British Tungsten

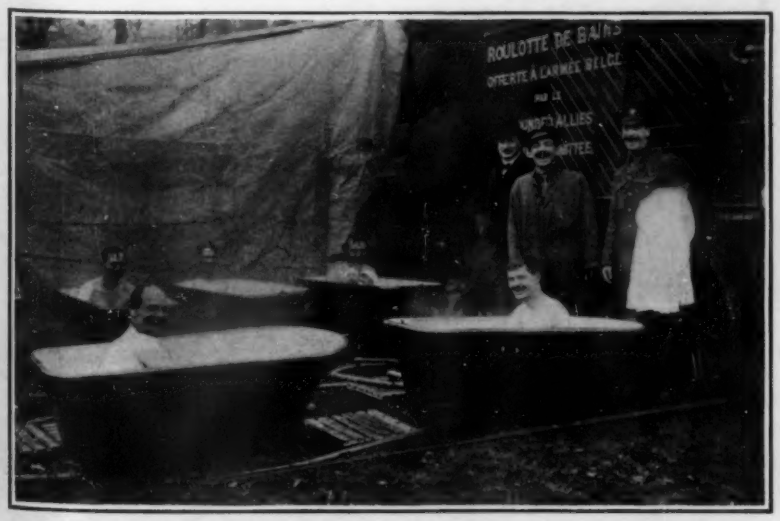
BEFORE the war practically the whole supply of the pure metallic tungsten which is used in making high-speed steel came from Germany. The outbreak of hostilities found other countries with a limited stock of the pure metal, and especially in England the demand for munitions brought at the same time a corresponding call for a large output of high speed steel. The position of the Sheffield toolmakers was so serious that, acting upon government advice, they organized a company to produce the tungsten metal powder. This company now embraces some thirty firms, whose combined output of high-speed steel before the war was about 80 per cent of the British total. A site was selected, work was started in November, 1914, and production commenced in July, 1916.

In September, 1915, the government took control of all the tungsten ore within the Empire, and arranged for its sale to makers through a government broker, a fixed price having been established. The prices realized for tungsten in other than British markets have at times been very much in excess of this fixed government maximum, but the Australian producers have loyally supported the Empire. The new enterprise is now on a sound footing.

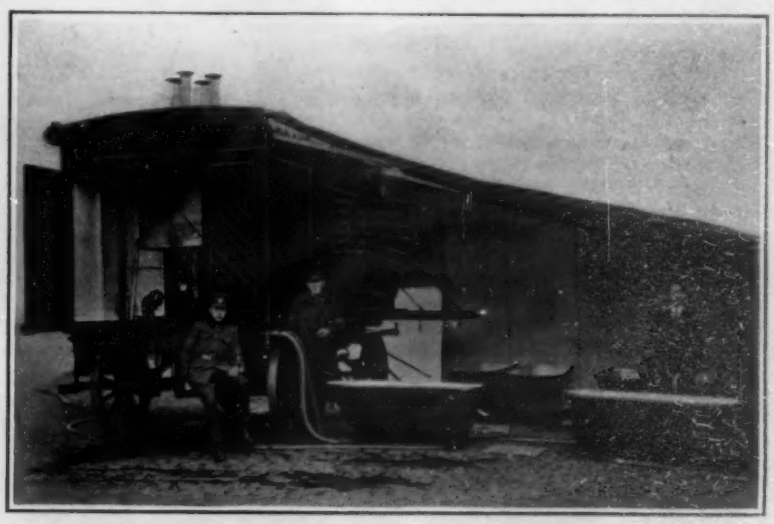
In addition to perfecting a plant so as to be able to deal with all kinds of low-grade and impure wolfram ore, the company has purchased mines in Burma, and has sent out a former member of the Indian Survey to take charge of the operations here. A completely equipped laboratory and magnetic separation plant have been sent out, and mining engineers, chemists and miners are at work at the company's branch in Tavoy. In this way the company has not only met the demands of home industry, but is assisting to improve the output of wolfram ore within the Empire. The record is highly creditable to all concerned, and should act as a stimulus to other undertakings of a similar nature, here as well as abroad.

The Canal Gunboats of the French Forces on the Somme

NOT to be contented with their numerous and powerful guns mounted on railroad carriages, the French forces on the Somme have also employed a number of stout barges mounting medium-sized naval guns. The Somme district, it appears, is perhaps better suited to the use of the gunboat batteries than the railway guns, for it is traversed by canals accessible to the French armies, and therefore available as a handy means of transporting the guns from place to place at all times except in the coldest winter weather, when ice forms on the surface in sufficient quantities to impede ready movement of craft. The railway guns, on the other hand, are held up during rainy weather because of the muddy and impossible condition of the terrain over which the rails must be laid before the guns can be moved forward. This photograph shows that the French are employing the usual canal barges for mounting naval guns up to, but probably not exceeding, 8-inch caliber. The guns are masked by the rows of trees that line the canals, hence are reasonably safe from enemy fire; and furthermore, should the enemy fire become threatening it is a simple matter to tow the battery up or down a few hundred yards.



British soldiers enjoying themselves at the practical test of the Belgian bath caravan or "roulotte de bains" in Regent's Park, London



Traveling bath caravan presented to the Belgian Army by the Wounded Allies Relief Committee, and inspected by King George at Buckingham Palace

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Chair that is Adjustable to Fit the User's Spine

HAVING come to the conclusion that to sit comfortably one must have a back rest which conforms with the contour of the spine, and, furthermore, that all spines are not shaped alike, A. Silbert of New York City has invented an adjustable back which may be built into any chair. His invention consists of an upholstered back shaped to fit the curve of the spine by means of a bulge, and the vertical position of the latter can be altered by turning a knob at the side of the chair. The sliding back is provided with a rack bar with which meshes a gear wheel operated by the knob within convenient reach of the sitter. Thus one can sit in the chair and turn the knob until the bulge of the back is adjusted to the spine and absolute comfort insured.

Rocking chair with a sliding back adjustable to fit user's spine

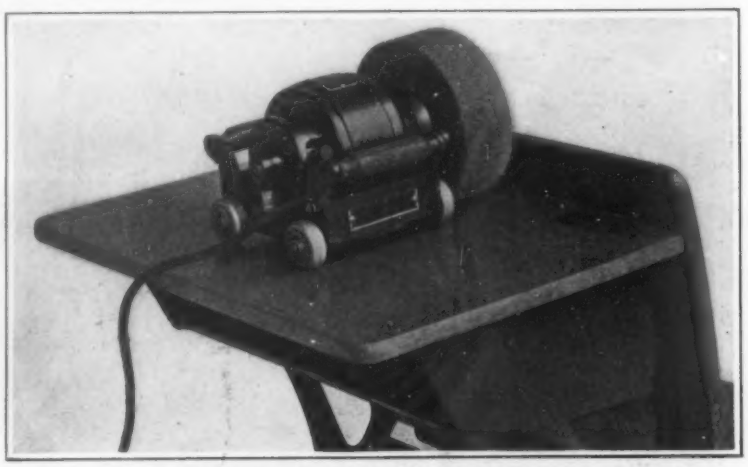
By bringing the back into proper position absolute comfort is assured

Making School Desks Like New

THE majority of school children are no respectors of school property. For this reason school furniture must be refinished repeatedly. To do this by hand has heretofore been a tedious as well as rather expensive job. An electric automatic desk sander does this work cheaply and speedily. The device is light and easily portable, can be connected to any electric light socket, and as its sander is a high speed one, making 1,800 revolutions per minute, the result is exceedingly satisfactory.

The sanding roller is mounted upon a flexible base which secures a yielding control. The cutting is done continuously as the roller is run back and forth across the surface of the work.

The wheels of the device are of wood, preventing any damage which might result from the moving of the machine. The sanding roller is 2½ inches wide with an 8-inch diameter. It should make a particular appeal to school authorities.



Cleaning off a school desk with an electric sander

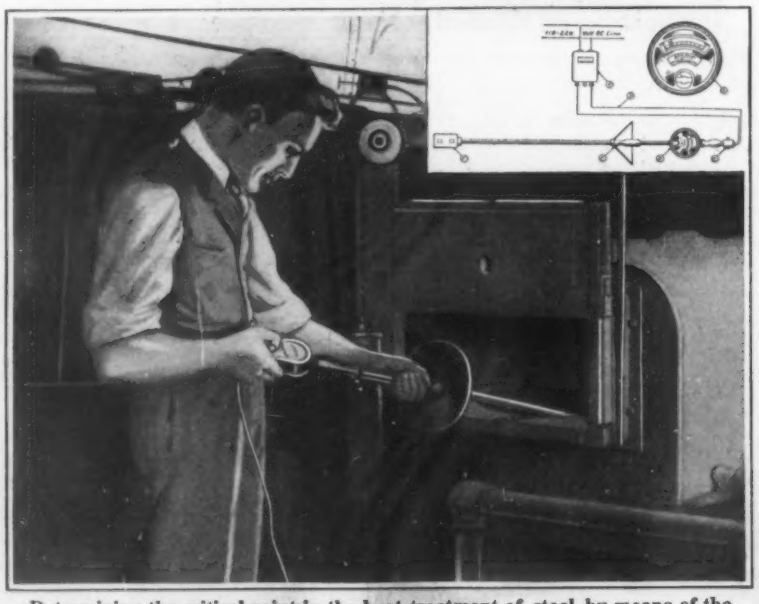
Paper Legs for the Disabled French "Poilus"

MADE from papier mache and costing not over 75 cents each, artificial legs of a temporary nature are now being supplied to disabled French soldiers in Paris hospitals. The paper legs, which are the invention of a Danish surgeon, are made on the spot. They can be used a fortnight after the amputation, and obviate the necessity for crutches while the patient is convalescing. A hospital orderly can cut the paper leg to the required size and fit and complete it for a patient in about half an hour. It is reported that the work takes a day to dry and set, and may be used the next day by the invalid. With proper care the paper leg should last from six months to a year.

What Holds a Mountain in Place?

RESEARCHES by the United States Coast and Geodetic Survey which are reported in Special Publication No. 40 of the Survey prove conclusively that the mountains (at least in the United States), are not held up above the surface of the sea by the rigidity or strength of the earth's materials, but that they are held in place by the fact that underneath them the materials (in the outer portion of the earth), are lighter than normal. The higher the mountain or the plateau, the lighter is the material under it, with relation to that of the surrounding lowlands.

The principle may be likened to that involved in the floating of an iceberg in the ocean. The portion of the iceberg which is visible above water is held up by the large mass of ice, with a density lower than that of water, in the submerged portion of the berg. So, in the case of the mountain mass, the portion above the sea level is held up by the lighter material under the mountain, which extends down to a depth of about sixty miles. While the mountain is held up or floated by a lighter material under it, the bottom of the ocean is depressed because the material under it to a depth of about sixty miles below sea level is heavier than normal. The normal condition may be considered that which obtains in the large river valleys and under the coastal plains.



Determining the critical point in the heat-treatment of steel by means of the device shown diagramatically in the insert

Wireless Telegraphy at the Ryerson Laboratory

WIRELESS telegraph apparatus has recently been added to the equipment of the Ryerson Physical Laboratory of the University of Chicago. The aerial is about 140 feet in height, and the length of the aerial conductor about 425 feet. The latter, consisting of eight wires of seven strands each, contains, including the leads into the building, nearly six miles of phosphor bronze wire. Although the installation is not complete, research in wireless telegraphy has already been begun, and arrangements have been made for coöperation in research with another university. Courses will be given next summer.

German Solders Containing No Tin

A SOLDER containing practically no tin, is reported to have been discovered by the Germans. Tin is scarce there now because none is mined in Germany and none can be imported. To provide a substitute cadmium was tried first, a metal similar to zinc, of which large quantities are found in Germany. An excellent solder was made from 80 per cent lead, 10 per cent cadmium and only 10 per cent of the now precious tin. This, however, could not be used for making and sealing cans for foods as the lead in contact with fruit acids produces poisonous salts. Bismuth, another metal found in large amounts in Germany, was then tried. This with cadmium and some other German metals formed a solder which is reported as non-poisonous and almost free from tin. A fourth of the 21,000 tons of tin imported and consumed by Germany in peace times is incorporated into solder. This new formula will help to solve Germany's tin problem, which must be serious, for a recent government decree has ordered the confiscation of the tin tops of all beer rings and steins. Even the church bells have been appropriated wholesale for their metal content.

The Loss of Magnetic Properties as a Guide in the Heat-Treatment of Steel

THE critical point in the heat treatment of steel is, as its name implies, all important. The temperature at which this critical point is reached in each steel is determined in the laboratory with the aid of elaborate apparatus; and in practical application the furnace temperature is raised somewhat above this point. The steel is then put in and brought up to what is supposed to be the temperature of its critical point.

Many factors have to be taken into account in this method. First, unwarranted credence has to be placed in the permanent accuracy of the pyrometer, regardless of the natural deterioration of of the thermo elements which are subjected to the temperature. Second, the element be borne in mind of the period of time nceessary in order that the steel may assume its critical temperature. Third, the personal factor then appears in determining whether the steel has assumed this temperature.

It is a well-known fact that steel in the process of heating loses its magnetic properties when it is brought to its critical point. Taking advantage of this phenomenon, there has been invented an ingenious device which serves to indicate the critical point in the heat treatment of steel. Through the medium of magnetic coils contact is made with the steel in the furnace and a magnetic indicator is placed in the circuit, which meter immediately indicates whether the steel has reached its critical point. The surface of the steel in time becomes non-magnetic, or in other words, up to the critical point. This is indicated on the meter by an approach of the needle toward the red line indicative of the critical point. As the heat penetrates the steel and the interior is brought to the critical point, the needle, on the indicator continues to approach the desired mark.

The new device does not measure temperature. When the critical point is indicated on the meter, no indication is given of what the temperature might be. The knowledge of this temperature is irrelevant; it is sufficient to know that the steel is at or above the critical point.

A Bureau of Standards for the Housewife

THE home of to-day is such an intricate organization, with its array of electrical and mechanical devices for simplifying the work and with its innumerable prepared foods, that the moment has long since arrived when there is as much call for a bureau of standards for the housewife as there is for the Bureau of Standards of the National Government, which is so liberally patronized by American industries. And the call has been answered: there is, and has been for some time, in New York City an institute that undertakes to test everything and anything that enters into the household, issuing its mark of approval to those articles that are found practicable from the housewife's point of view, and witholding its approval from others.

The work of the housewife's institute is as diversified as it is intensely interesting. Naturally, there are two general classes into which the activities divide themselves, namely, the testing of food products and the testing of electrical, mechanical and other types of devices. As the various food products make their debut in the market they are brought to the kitchen of the institute and cooked according to the directions of the manufacturer. Every facility is available in this kitchen, including gas, oil and electric stoves so that the kitchen conditions of any home, from the ultra-modern, electrically equipped bungalow to the settler's shack, can be duplicated. But, in addition to the usual household facilities, there are here to be found all manner of scientific instruments for ascertaining the vital facts regarding the samples under test.

All the personnel of the institute are women, hence the articles submitted for approval are sure to be considered from the feminine viewpoint which, after all, is the only one that generally counts in the equipping and maintenance of the home. And, strangely enough, this viewpoint does not always agree with the engineer's. For instance, not so long ago the institute received for test a combination stove-top and water heater. Engineers had expressed the greatest enthusiasm over the high thermal efficiency of this device. Yet, when the practical women scientists of the institute gave the device a thorough test under household conditions, they found that it required too much fuel for its operation; in other words, it was nominally efficient—but efficient at a cost that precluded its use in the average household.

Vacuum cleaners, while they all look more or less alike, vary to a great extent as regards their capacity for work; but in the hands of the institute's staff the real value of any vacuum cleaner is soon arrived at. As a first consideration the suction properties of a given sample are tested out by means of a U-shaped glass tube, filled with colored liquid. A hose leading from the vacuum cleaner connects to one leg of the U-tube, so that when the suction is applied the liquid rises in that leg and gives a reading on a calibrated scale. This, then, is the first test; the second calls for an actual working test. A certain amount of dust, carefully weighed, is placed under a rug and the vacuum cleaner passed over the rug for a given length of time, at the end of which the rug is lifted and the remaining dust gathered up and weighed; and in this manner it is a simple matter to determine how much dust has been removed. "Any vacuum cleaner can take the dust from the top of the rug," state these practical household specialists, "so in our tests we make the vacuum cleaner remove the dust that is under the rug."

Volts, amperes and watts have no terrors for the practical women-electricians of the institute, for they speak in these terms with the greatest ease. Indeed, all kinds of electric measuring instruments are used in their tests of electrical devices, and many an advanced electrical engineer would find himself seriously embarrassed in discussing the relative merits of electrical household appliances with these women-electricians; for the latter speak from intimate experience with the subject.

And so the work of the housewife's institute runs, day after day and year after year. The woman of to-day no longer is compelled to judge a new product on appearances only or by hearsay; for if the manufacturer has submitted his product to the institute and it has been passed upon, she may be certain that it is in every way worthy of entering her home.

The Cunning Displayed in the Sinking of the German Steamer "Liebenfels"

(*Concluded from page 367*)

to enter the hold. In order to hamper the work of the divers as much as possible, obstructions were placed in his way and for example, an iron ladder was jammed up against the main sea valve in such a way as to prevent anyone from reaching it. The diver had to raise the plating in the floor of the engine room and pass under this through a complicated mass of piping to reach the main sea valve.

Everything was done in a very thorough manner except that the crew neglected to destroy or throw away all the valve disks. Many of them were found scattered about the vessel and were fitted back in place. In other cases, wooden disks were made to take the place of the valve disks destroyed. In order to seal the openings perfectly, Portland cement was used. The glands about the propeller shafts had also been removed to admit water, and there were leaks in the boilers which would admit water from the sea by way of the piping system.

For salvage of the vessel, after all these openings had been sealed, the hatches, where necessary, were fenced about with cofferdams extending to the surface of the water. Then powerful salvage pumps were installed and the hull was pumped out.

Our pictures show the work on the vessel in various stages. A great deal of credit is due to Major Youngberg and his assistants. The work of the divers and preparations for raising the ship occupied nearly four weeks; and the time required to pump the ship out was about five hours. Major Youngberg made full use of the resources of the various Government Departments, namely War, Navy and Lighthouse, at Charleston. Some of the salvage pumps were furnished by Mr. W. Wotherspoon, but with this exception, all the equipment used was part of the Government establishment, and the excellent work accomplished showed the state of preparedness and efficiency of the Government engineers.

Sulphite Coal: a New Fuel

A NORWEGIAN engineer, Mr. R. W. Strehleners, has devised an ingenious method of reducing the cost of paper manufacture by utilizing the residue from the mills to produce a fuel which suffices to run the plant. The paper pulp obtained from wood constitutes only 45 per cent of the wood, and the residue of 55 per cent has hitherto been found useful chiefly for the wood alcohol and acetic acid obtained from it by distillation, Mr. Strehleners has recently perfected a process by which the residue furnishes a fuel in the form of a powdered coal or charcoal which is said to evolve great heat in combustion. The first plants have been erected at Greaker, on the Christiana fjord, and it is stated that they will shortly be able to yield an annual output of 6,000 tons of this new fuel. This will suffice to supply all the cellulose plants in Greaker with an inexpensive fuel, at the same time that it rids them of a burdensome incumbrance. Since the total production of paper pulp in Norway is estimated at 1,000,000 tons yearly, doubtless the other plants throughout thecountry will soon be similarly equipped.

Spinel Refractories

THE U. S. Bureau of Standards has been experimenting for some time in the preparation of spinel (magnesium aluminate) refractories and announces that it will soon be in a position to assist American manufacturers in the production of such refractories, the making of which has, in the past, been chiefly confined to Germany.

The Embodiment of Strength

Brooklyn Bridge, flung forward span on span across the sky—great towers thrust upward to the clouds—huge ships hurled onward over seas—what is the secret of their majesty?

Not flash of forge or skill of hand, but power of mind—a principle old as engineering; old, almost, as man's inventive urge—the principle of distributed stresses, of many small units to carry a single great burden.

An old principle, yet ever reappearing in new guise, put to new uses, serving in new forms; now the basis for a temple, now a bridge, a skyscraper, a ship—now an automobile tire.

Yes, even an automobile tire, forgotten carrier of man's pleasure and errand, preserver of his comfort and celerity awheel—the Goodyear Cord Tire.

For the structure of this tire draws strength from the soundness of this old principle of distributed stresses—endurance from its vitality, broad usefulness from its immense efficiency.

The structure of this tire *embodies* this principle, from beginning to end. Goodyear Cord Tires are built up of thousands of light, pliant cords, densely strong, cradled side by side in pure rubber, without interweave.

Each cord is stressed precisely to the same tension, that the burden of supporting the load and sustaining shock shall be evenly borne.

But the performance of this service does not depend upon just one layer of these cords.

Nor upon two, or three. It is distributed and redistributed, throughout the entire tire, over *many* layers, established one upon the other.

These many layers are laid diagonally around the tire, expertly brought taut to share their rightful portion of the load, and made fast.

No one of the layers, nor one of the cords, touches another.

For as the cords themselves are insulated and upholstered with rubber, so are the layers—rubber is cushioned around, about, between, actually impressed *into* them.

Contact is wholly prevented; there is never an opportunity for the slightest side-saw or friction.

The cords and layers play freely in their cushioned anchorage; under impact they yield, flex and recover, exercising swiftly to the lift and dip of the road, delivering engine power at its full energy.

Comfort, speed, endurance, power-saving and fuel-thrift ride with the car shod with Goodyear Cord Tires.

They cost us more to build than other types—but the extra cost is *in the tires*, in extra materials, in labor, in values that pay back real return on your investment.

Their quality makes them higher-priced—and *better*.

GOODYEAR
AKRON
CORD TIRES

it doesn't count here, but—

Out There it's Money Lost

A LITTLE dust on the office desk doesn't matter. A flick of the cloth and it's gone. But in the warehouse, shipping room, machine shop, etc., cement dust from the soft-surfaced, crumbling cement floors plays havoc with merchandise, ruins the delicate adjustments and bearing surfaces of machinery, carries disease germs and creates unsanitary surroundings. Such floors represent a money loss as surely as fire or any other destructive agent about the building.

ARCO VITROGRAIN

saves Floors, Merchandise, Machinery, Men

Arco Vitrograin is a liquid chemical treatment which can be applied in a few hours, at night if necessary, without disturbing production, moving equipment or employing outside labor. It combines with the free lime in the floor, reduces porosity, knitting the loose particles into a rock-hard, dust-free surface. By removing the menace of cement dust it saves the health of workmen, protects merchandise, preserves your floors and is life-insurance to your machinery. By these results plant maintenance is reduced by hundreds, even thousands, of dollars.

Arco Floorcote, a paint-film product supplied in various colors, is recommended for use where a decorative as well as dustproof coating is desired.

Arco Solidizer, a metallic hardener added to the topping at the time the floor is laid, is the ideal treatment for wearproofing floors of heavy manufactories, warehouses, loading docks, shipping rooms, foundries, etc.

Send us full information regarding your floor problem and we will reply in detail.

2144 WISE BUILDING **THE ARCO COMPANY** CLEVELAND OHIO
Founded 1880
Paints, Varnishes and Enamels

CORNELIUS VANDERBILT

Inventor, Engineer, Soldier, Financier, Patriot—His story

by B. C. FORBES

in this week's

Leslie's

Illustrated Weekly Newspaper
Established in 1855

225 Fifth Ave. New York City

NEW BOOKS, ETC.

WEBSTER'S COLLEGIATE DICTIONARY. Springfield, Mass.: G. & C. Merriam Co., 1917. 8vo.; 1248 pp.; 1700 illustrations. Thin paper edition de luxe. Prices, art canvas, $3.50; full seal, $5; full levant; $6.

In its physical make-up, this book is a dignified and beautiful example of the publisher's art; the employment of thin paper has resulted in a lightweight volume very easy to handle, and of which it is hard to realize that it is the largest abridgement of Webster's New International Dictionary with most of the essentials of the unabridged work, complete definitions, and adequate etymologies, and including familiar diacritical marks and respellings to indicate pronunciation. The main body of the work is lavishly illustrated and thumb-indexed, and in addition there are pronouncing vocabularies of Scottish words and phrases, rimes, geographical and biographical names, Christian names, and foreign words and phrases, with further lists of abbreviations and arbitrary signs, and a section on punctuation and the use of capitals. Even for those who have access to larger dictionaries this compact and convenient volume, occupying little space on the desk or table, will save much time and fatigue, since in the majority of cases it will answer every purpose and obviate the necessity of resorting to a more ponderous and exhaustive work. It is also issued in cheaper editions.

A TEXT-BOOK OF GENERAL BACTERIOLOGY. By Edwin O. Jordan, Ph.D. Philadelphia: W. B. Saunders Company, 1916. 8vo.; 669 pp.; illustrated. Price, $3.25 net.

This is the fifth and thoroughly revised edition of a text first issued in 1908 and since come to be well known. Among the entirely new material is found a chapter on typhus fever, and there are new sections on the Schick reaction, mouth entamebæ and Hodgkin's disease; the sections on disinfection and the testing of disinfectants have been rewritten, and contain a full discussion of the later methods. The work is the outgrowth of lectures delivered before the University of Chicago, and since the subject is not only of interest to medical students but also bears upon household administration, agriculture, sanitary engineering and various other industries and pursuits, the text should appeal to the general scientific student and reader. It is not intended to meet the needs of the advanced worker, but is a good general introduction to bacteriology, setting forth the methods of laboratory work, dealing with bacteria from their discovery to their present uses in the arts and industries, and providing bibliographical references for the special investigator. The subject is covered with commendable attention to perspective, and an appendix deals with infectious diseases of doubtful causation.

ON THE BATTLE FRONT OF ENGINEERING. By A. Russell Bond, Managing Editor of the *Scientific American*, author of "With Men Who Do Things," etc. New York: The Century Company, 1916. 12mo.; 300 pp.; illustrated. Price $1.30 net.

Seldom do we find a book for boys written with so ingenious a blending of story and instruction; nor is there in it the slightest suggestion of the sugar-coated bolus—a thing the youthful vision is remarkably quick in perceiving, and quite as prompt to reject. The heroes of this rattling good yarn are two real boys whose thirst for knowledge of the big things that men are doing in the world leads to their participation in some of the epoch-making feats of modern engineering, and this participation naturally leads in turn to thrilling adventures. No live boy can read this story without alternate quickenings of the pulse and the brain. The author has taken the greatest care to describe the engineering principles and methods involved with absolute accuracy, yet in the simplest and most interesting manner; no one reading Mr. Barto's explanation of the "K" type of cantilever can ever forget the principles of that construction; the very chapter headings lure the reader on from page to page. What boy would not rise to the bait of "Kelly's gasoline elephant," or "light and heat from snow?" What boy could be apathetic, standing before the greatest engineering triumphs of the world—the biggest aqueduct, the largest electric power plant, the most wonderful bridge? He has no choice but identify himself with one of the youthful heroes, to fight manfully with them on the battle front of man's struggle against stupendous natural forces, and to exult with them in the subjugation of roaring streams, the victory over apparently unconquerable obstacles, and the harnessing of Nature's wild horses to the work of mankind. The narrative is at once clever and sincere, and will prove an excellent stimulant for the latent forces of the growing mind.

TRANSACTIONS OF THE AMERICAN CERAMIC SOCIETY. Vol. XVIII. Arthur S. Watts, Editor. Columbus, Ohio, 1916. 8vo.; 947 pp.; illustrated.

This substantial volume contains the papers read at the meeting held in Cleveland in February of last year. These annual meetings never fail to give birth to some most interesting discussions, and those who are in any way connected with the arts and sciences related to ceramics can scarcely afford to ignore this setting forth of modern problems and modern methods. No less than fifty-five papers are presented, and their scope may be judged by a few subjects taken at random, such as chemical porcelain, fire brick, barium glasses, sing paving brick, pyrometry, and Kansas shales. Pertinent criticisms and questions by members follow many of the papers, admirably

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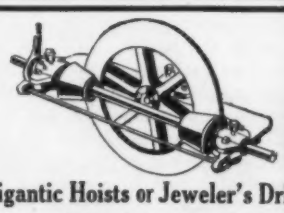

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disclosing the strong and weak points of the speaker's arguments. The annual report of trustees and much information concerning the Society is also embodied in the volume.

THE SPELL OF SCOTLAND. By Keith Clark. Boston: The Page Company, 1916. 8vo.; 375 pp.; illustrated. Price, $2.50 net.

With a depth of understanding and sympathy the author of "The Spell of Scotland" paints for us the Scotland of to-day, and since it is the persistence of the past that makes this enchanted ground so subtly alluring, a background of history is introduced against which modern life appears in discreet relief. The charming illustrations impart to the delineation a light and shade, and a definition, that add not a little to the satisfaction with which we turn the pages; and although the style at times becomes a trifle labored, the reader concludes the volume with a feeling that he has actually traversed the ground covered by the author. Aside from the useful information offered the intending tourist, or the more or less transitory pleasure derived from its perusal, the book will help the reader to a more intelligent and appreciative grasp of the many works of poetry, fiction and travel which take Scotland for their setting.

THE SPELL OF THE HAWAIIAN ISLANDS AND THE PHILIPPINES. By Isabel Anderson. Boston: The Page Company, 1916. 8vo.; 382 pp.; illustrated. Price, cloth, $2.50 net; three-quarters morocco, $5 net.

Those who are familiar with other works of this travel series by the same author need fear no disappointment in her new volume that, dealing as it does with our Pacific possessions, should make a strong appeal to the average American reader. The author has had exceptional opportunities for studying the scenery, institutions and people of these islands, and her volume covers historical and political conditions as well as the more human and intimate matters of life and customs; the style is colorful but not high-flown, and much solid information is interspersed with the purely descriptive material. There are two good folding maps, one of the Hawaiian Islands and the other of the Philippines, with six full-page illustrations in color and many duogravures. The result is a most attractive volume that fully attains the standard set by preceding works of the Spell Series.

JOSEPH PENNELL'S PICTURES OF THE WONDER OF WORK. With Impressions and Notes by the Artist. Philadelphia: J. B. Lippincott Company, 1916. 8vo.; 52 subjects. Price, $2 net.

Joseph Pennell is a man with a purpose; he would glorify modern labor and the grim scenes that it creates. His straight-spoken preface makes his attitude plain, and the short paragraphs that introduce each picture give even more definitely his aims and methods. With a firm, bold hand he sketches for us the buildings of Philadelphia, the oil wells of Alberta, Chicago's bridges from below, steel works, coal breakers and powerhouses; we are whirled to Venice, to witness the rebuilding of the Campanile; to England, to gaze upon giant stacks and fiery waters; the bridges and shipyards of Germany, the furnaces of Charleroi, the crater of Creusot, are powerfully delineated. Among the more striking pictures are a shop interior at the Krupp's works, the harbor of Genoa, and the new bay of Baie, Italy. Judges will disagree as to the relative artistic values of these sketches, but none may deny that the collection demonstrates the fact that industry has a true and strong artistic appeal.

OUR MILITARY HISTORY. Its Facts and Fallacies. By Leonard Wood, Major-General, U. S. Army. Chicago: The Reilly & Britton Company. 12mo.; 240 pp.; illustrated. Price, $1 net.

The past two years provide a record of wasted opportunity. Europe had burst into flames, the sparks were menacing the whole world, yet we looked on, careless of the peril of these flying sparks spreading the conflagration to our own homes. General Wood, an authority who can scarcely be accused of militarism even by his worst enemy, has in this well-written little volume admirably set forth the cost of our unpreparedness, and the history of the struggle for peace both in its commendable and its ill-advised aspects, with a valuable summary of our past sound national policy succeeded by seventy years of inefficiency. Confucius said that to lead an uninstructed people into war was to throw them away, and that we may be forced rather than led into war does not impair his statement; with the intricate fighting machinery of today, its truth is augmented. Finally General Wood shows us the value of preparedness, points out exactly what we must do to retrieve ourselves from a dangerous position, and demonstrates that our army is a potent factor in constructive work and the development of our resources. His tract most convincingly marshalls the facts which every American must know before he can reach conclusions of any value.

SUPLEMENTARY MAGIC. By Elbiquet. New York: E. P. Dutton & Co. 8vo.; 208 pp.; illustrated. Price, $1.25 net.

In "A Text-Book of Magic" the author gave us a primer of the art of conjuring; this supplementary volume deals with new and improved methods of presenting illusions and provides a generous assortment of tricks; but the chief value of the work lies in its application of the principles of efficiency to the psychology of magic, and this psychological survey is thrown into relief by a dissection of the bold methods of the native Indian conjuror.

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(14211) T. C. T. asks: 1. Please tell me how to solder copper, what acid, straight or cut sulphuric and the part resin takes in soldering, and how and when to use it? 2. Please explain the following: We have had a very severe cold spell here for a long spell, being from 22 to 45° below zero on the 31st of January the thermometer registered 23 at noon and gradually fell, and at 6 P. M. was 38 and at 10 P. M. below 45°, farther down than the last mark on the glass at 12 M., the mercury was all in the bulb, but a very little. At daylight it registered 22 above zero (the coldest 22° above I ever want to endure), and as the day went on it rose and finally hit the top of the tube and has been there ever since (a small cheap one hanging out did the same). What happened? Did the mercury freeze? What degree does it freeze? That day our barometer went the highest we have ever known it. 3. What causes "Sun Dogs?" also "Moon Dogs" and "Northern Lights?" A. 1. Copper is very easily soldered. The parts to be soldered must be clean. If corroded they must be scraped. Then cover the clean copper with a soldering paste, not an acid, since any acid flux will corrode the copper and injure the work after it is finished. Now apply the solder as in soldering tin. The solder flows easily on clean copper. You can obtain a non-corrosive soldering paste from dealers in electrical supplies. Rosin or any other flux protects the clean surface from being oxidized when it is heated by the soldering tool. 2. The freezing point of mercury is 40 below zero. The mercury in your thermometers froze at that temperature, and probably the glass cracked and the air forced the thread of mercury up to the top of the tube when it thawed as it did when the temperature went above 40 again. We doubt very much if the reading was correct at daylight, 22 above zero, when it was more than 45 below at the midnight previous, a rise of 66 in less than six hours. 3. Sun dogs are portions of Halos. They are due to the refraction of the light by ice crystals in the upper air. They, occur where rings of the halos cross each other. Moon dogs are similar but seen at night. Auroras are due to electricity in the upper air like the light of an electric discharge in a vacuum.

(14212) S. G. C. K. asks: Will you kindly give me the answers to the following questions through the Notes and Queries Columns. 1. How does soap perform its function of cleansing? When an alkali is added to a fat we get a neutral "salt" of the fatty acid, soap, yet this substance is capable of removing fat. It is by solution, or emulsification, or is there a chemical change in the fat removed? 2. What is a "super-fatted" soap? Merely a soap with an excess of free fat? If so, how does it cleanse? 3. How can turtle shell ("tortoise shell") be welded? Globes for umbrella handles are made of genuine turtle shell. These do not appear to be merely cemented, nor are they merely clamped together by mechanical means. It would appear therefore that the shell, which is never more than say a quarter inch in thickness, must be welded. A. 1. The Ency. Brit. Vol. XXV. Eleventh Edition, Art. Soap, states the several theories of the cleansing action of soap as follows: "Soap when dissolved in a large amount of water suffers hydrolysis, with the formation of a precipitate of acid salt and a solution containing free alkali. The reception is however very complicated. As to the detergent action of a soap, Beszelius held that it was due to the free alkali liberated with water. It is more likely that the cleansing power of soap is due to the inherent property of its solution to emulsionize fats. Hillyer concluded that the cleansing power depended upon several factors, *Viz.*, the emulsionizing power, the property of penetrating oily fabrics, and lubricating impurities so that they are washed away readily." 2. We are not familiar with the term "superfatted soap." It would seem to indicate a soap in which saponification is not complete and would proceed slowly for a time till the soap is ripe. 3 Tortoise shell is welded by softening it by heat and welding by pressure. It is formed in this way into the shapes in which it is sold.

(14213) J. C. McK.: It is known that when two dissimilar metals are soldered together, such as iron and copper, and the junction of the two metals is subjected to heat, that an electric current is generated. Is there any possibility of producing *commercial* electric currents through this source? What combination of metals gives the most powerful current, when treated in this manner? Does the idea offer any possibilities for research, with the view of making a practical electric generator? Kindly refer me to literature on the subject, if any is published. A. There does not seem to be much chance that a commercial thermo-electric generator can be made for commercial use. The electromotive force produced is proportional to the difference of temperature of the hot and cold junctions, and with a very great difference of temperature a very small electromotive force is produced. Metals with high melting points should be used and these are very expensive. Several attempts were made a while ago to put such a generator on the market which would give current enough to charge a small storage battery for ignition purposes. It was not a success. The literature of the subject is meager; there is a chapter in most college text books of physics. You will find the facts in the case well-presented in Thompson's Elementary Lessons in Electricity, which we will send for $1.50 net, postpaid $1.65.

(14214) E. R. C. asks: Ganot's Physics says that bodies weigh nothing at the center of the earth. How is this reconciled with Newton's law, *i. e.*, $F = \frac{mm'}{d^2} g$, where d is the distance seperating centers of two mases m and m. If d approaches o, it seems that F. would approach infinity. A. It is demonstrated in text-bookss of mechanics that bodies on the surface of spheres of different radii, but of the same density vary in weight as the radii of these spheres, so too it is demonstrated that a body within a spherical shell is equally attracted by the shell in all directions and will have no weight. From the second statement we infer that as a body descends into the earth the shell of earth exterior to that body will cease to affect its weight and only the sphere nearer the center of the earth will attract the body. We infer from our first statement that if this sphere were of the same density to the center, the weight of the body would diminish in the same ratio as its distance from the center of the earth, and at the center of the earth the body will have no weight. The mass of the attracting sphere would become zero when the body was at the center of the earth, and so the mm' of your formula would be zero, and the value of the resulting force would be ze.o . All textbooks agree in the statement which you quote from Ganot.

(14215) T. B. W. asks: Will you be good enough to give me some information as to how to subdue the sound in a closet in which I want to put my house phone? The conditions are these. It is situated under a stairs, lathed and plastered inside, and I should say about a 4-inch space and hard-wood finish on one side of the wall and lath and plaster on the other side, that is, next the drawing-room. The door is of the ordinary panel variety. I find when speaking inside with the door shut one can be heard almost the same as when out in the room. Would lining the inside walls with folded newspapers and then a thick sheeting of fiber board do any good? Anything you could advise would be much appreciated. A. We suggest that you cover the walls of your telephone closet with heavy shawls or felt, and put in a double door such as is used in the public telephone booths. This will probably remedy the difficulty you experience in being heard outside of the closet. Paper covered with fiber board will not be satisfactory, unless the papers were very loose and fluffy. In that case they would probably answer the purpose. The door is probably as much or more responsible for transmitting the sound as the walls. Plastered walls are quite resonant but wood is quite as resonant. Felt an inch thick would probably be sound proof.

(14216) A. B. B. asks: On page 46 of the SCIENTIFIC AMERICAN of Jan. 6, 1917, third column, beginning line 23, in an article "Attacking the Motor's Mightiest Enemy," by John S. Harwhite, is the statement "While carbon in its free state is practically incombustible," etc., I am writing you to ask if this above referred to statement is correct. I have taught, in my Chemistry classes that carbon is combustible, and burns in air forming carbon dioxide. A. We submit the combustibility of carbon "in its free state" to you for experiment. Take some powdered electric light carbon, or that from a piece of battery plate, and try to ignite it with a match or a gas jet, for that matter, and you will find it will take quite a time to get it on fire. Even with a lump of charcoal or powdered charcoal even, you cannot get a blazing fire. You will get but a glow of fire. A splinter of wood contains carbon, oxygen and hydrogen, so that it can quite well support combustion by itself; but even so, to make a good blaze much oxygen from the air must be supplied. Powdered charcoal will burn with violence in pure oxygen, but in the air it will burn but slowly at the very best. We cannot take exception to the statement in the article referred to in your letter.

(14217) C. J. L. asks: Please inform me through your valuable paper, how wave length is determined in Wireless. I read of 200 meter wave length and also greater. Don't quite get it clear. A. The length of an electric wave is determined by a wave meter. The natural wave length of an aerial is four times its linear length, just as the wave length of a note of a closed organ pipe is four times the length of the pipe, and the wave length of the note of a tuning fork is four times the length of the box which is resonant with the note. However, other considerations make it difficult to measure the wave length by a rule and the wave-meter gives a more correct result than can be found by measuring the length of the wire.

(14218) C. E. G. asks: People use the expression "It is too cold to rain." Or "It is too cold to snow." Now, I contend it is never too cold to precipitate. How is it? A. You are probably quite correct in maintaining that it is never too cold to have precipitation, since there are very severe snow storms in the coldest regions of the earth, the Polar regions. It is, however, a matter of common observation in our latitude that we have snow frequently when it grows warmer in winter after a cold time. This gives rise to the common saying which you quote. It seems to have a basis of fact behind it and to be rather a good weather sign.

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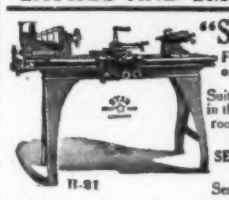

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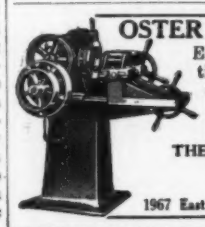

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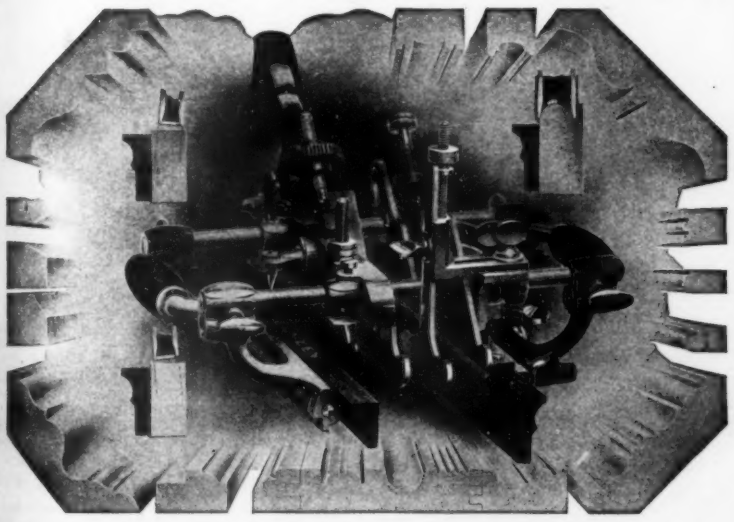

Stanley "Fifty-Five" Plane

The above cut shows the STANLEY UNIVERSAL "55" PLANE together with samples of mouldings that can be made with the fifty-two cutters furnished with the Plane.

This well-known tool has earned for itself with carpenters and mechanics the reputation of being "*A Plaining Mill within itself.*" With it a greater variety of work can be done than with any other Plane or set of Planes now on the market.

It is 10 inches long and weighs only 7¾ pounds.

Cutters of practically any form can be used in the Plane, which the owner can make from blanks or order from sketch.

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"55" Plane and How to Use It

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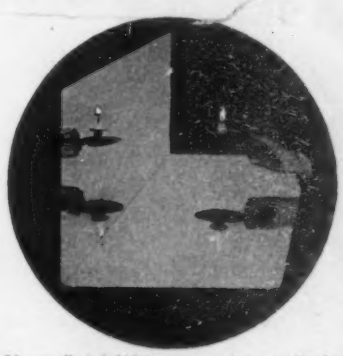

If a candle is held between two mirrors inclined at right angles, three images are reflected as seen in the picture, but the effect is a dazzling glare.

Suppose the experiment shown above in the circular insert were made in your factory—suppose you had mirrors on your ceilings and walls and a strong beam of sunlight instead of a candle. What would be the effect? The rays of light that struck the mirrors would be reflected. You would have enormously increased light. But the dazzling glare would be unbearable—impossible to work by.

Suppose, now, that you could find some surface that would reflect as much light as a mirror but would eliminate the dazzling glare; a surface that would give you the same increased quantity of light, but soft and evenly diffused.

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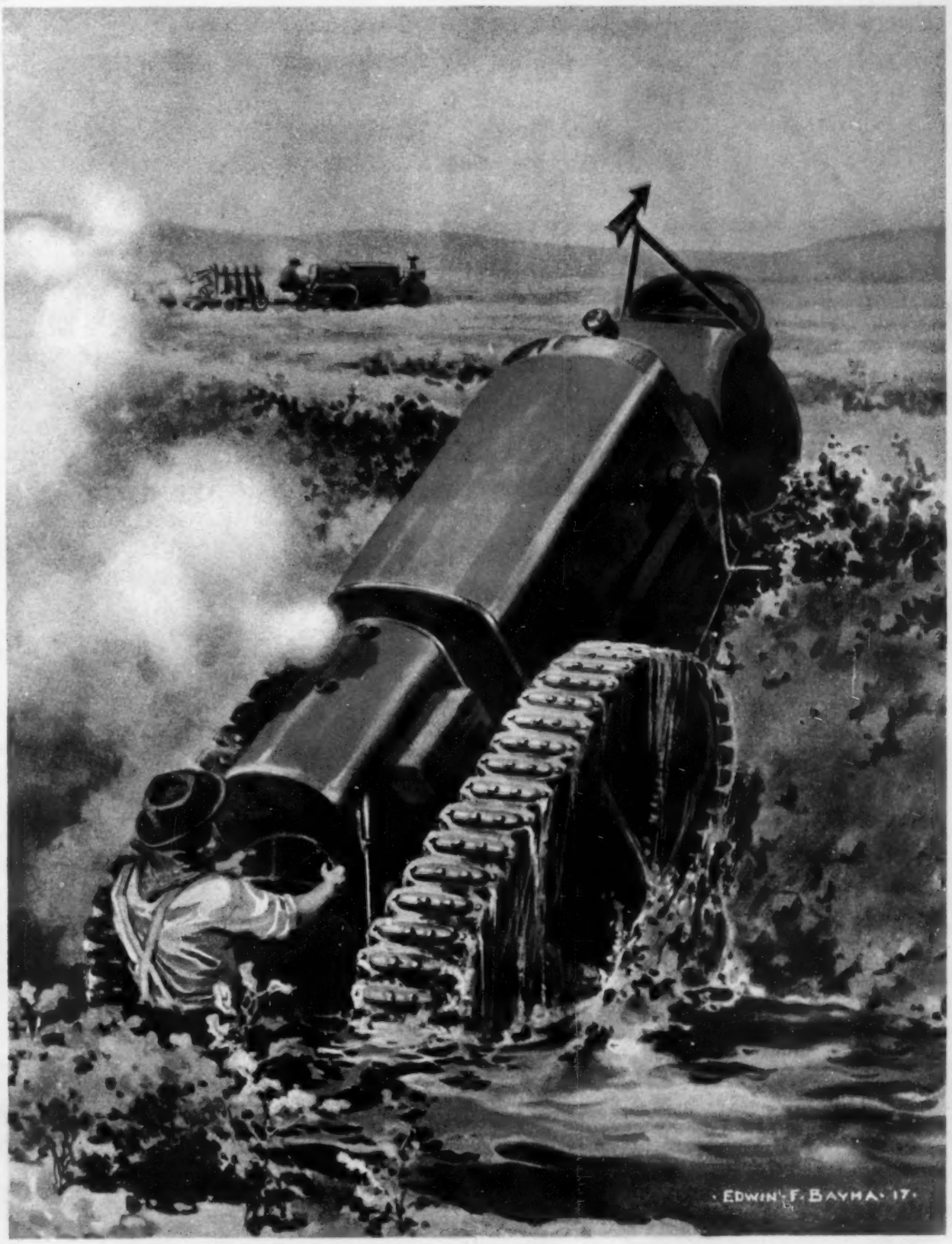

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